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TROPICAL DISEASES BULLETIN

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General Editor:
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COMMONWEALTH MYCOLOGICAL INSTITUTE
26 MAY 1971

London:
TROPICAL DISEASES BUREAU,
Imperial Institute, S.W.

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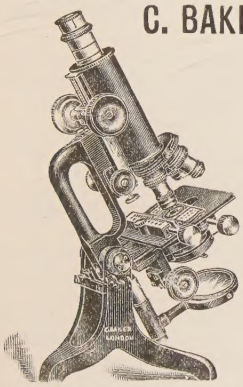

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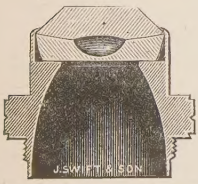

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TROPICAL DISEASES BUREAU.

TROPICAL DISEASES BULLETIN.

Vol. 6.] 1915. [No. 5.

APPLIED HYGIENE IN THE TROPICS.

By Colonel W. G. King, C.I.E., I.M.S. (Retired).

REPORTS.

British Guiana (1913–14).*

The Report of the Surgeon General for 1913–14 shows that the total population of British Guiana gained during the year an increment of 5,000, making the total 303,984.

The birth-rates have shown an increase, the death-rates a decrease, as follows :—

Year.	*Birth-rate.*	*Death-rate.*
1911	28·8 per mille	31·7
1912	33·1	29·2
1913	34·6 ,, ,,	24·2

From 1907 to 1911, there was unusual rainfall; in 1912, drought occurred. The Surgeon General suggests that the latter condition has aided the attainment of improved death statistics. Malarial fevers, ankylostomiasis and syphilis are the chief causes of absence of resistance to acute diseases. No epidemics occurred during the year. Yellow fever has not exhibited itself since 1883, and plague and cholera are unknown.

In his Report for 1912–13, the Surgeon General found good ground for pessimism in regard to the sanitary condition of Georgetown. He then stated: "Were it not for matter of sanitation effected by the breeze and sun, Georgetown would be as hideous as some of the cities of the Middle Ages when affected with plague." He is now able to state that the Mayor and Council of Georgetown have established "a special sanitary department supervised by a whole time Medical Officer of Health and strengthened by the appointment of a Chief Sanitary Inspector with English training and experience," and that these new arrangements "have more than ample justification for the special expenditure." Only once before in twenty years (1901) has

* Report of the Surgeon General for the Year 1913–1914. [Surgeon-General K. S. Wise]. 112 pp. 1914. Georgetown, Demerara: The Argosy Co., Ltd.

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the birth-rate (30·6 per mille) exceeded the death-rate (26·5 per mille) for 1913–14. He regards this as "eloquent testimony to the value of the service rendered by Dr. Wishart," the whole time Medical Officer of Health. He is further able to state that the town of New Amsterdam "has made efforts to meet the demands for sanitation by the appointment of two Sanitary Inspectors."

The fact, however, remains that there is much to be done in Georgetown, before it can no longer be regarded as a peril to the rest of the Colony. In 1913–14, 254 notifications of typhoid fever were received in Georgetown, plus 10 in its environs. In the whole Colony, the average deaths per annum from this disease between 1886–1890 were 6·6; by 1906–1910, the annual average was 27·6. Since the latter period, the annual deaths have been in 1911, 76, in 1912, 93, in 1913, 106. The moral drawn by the Surgeon General is, "the City of Georgetown is the home of this disease, and the more persons infected the more carriers will exist, and the further over the Colony will the disease spread."

As to New Amsterdam, the hopeful statement is made: "The town is favourably situated, well laid out and not overcrowded. With comparatively little expenditure and attention it might well be a model for tropical towns." Evidently, the Surgeon General believes it is cheaper in human life and funds to require a town "in the making" to enforce sanitary requirements than in after years to attempt amelioration of conditions arising from their having been ignored.

In the forest hinterland and in the savannah, lies the future wealth of British Guiana, and it is therefore satisfactory to find it emphatically stated:—

"The recent large expedition which accompanied His Excellency the Governor on a journey of two months through the forest regions to the southern savannahs, has shown that the adoption of suitable precautions renders travelling in the hinterland forest areas almost devoid of danger. . . . . The savannah land, though but a degree or two from the Equator, is remarkably healthy and probably the healthiest part of the Colony."

As to village areas, sanitation is still conspicuous by its absence; so it is not surprising to find that deaths exceed the births. But the sugar estates, which employ indentured as well as free labour, exhibit a contrast more than sufficing to show that disease preventive measures in rural areas would rapidly secure the chief requirement in economic advance in this Colony, namely, cheap labour.

As a result of minor anti-malarial measures, such as "the abolition of mosquito breeding places, screening of barrels and other receptacles, the free distribution of quinine to resident labourers and especially to children" the following marked decline of malaria cases treated in estates hospitals has been secured:—

Average for 5 years

1906–07 to 1910–11	27,444
1911–12	15,028
1912–13	7,284
1913–14	7,447

Nor has the influence of Applied Hygiene been limited to raising the value of capital spent in labour, by reason of decreased sickness. The majority of labour for British Guiana is costly because it is imported. But the following statistics show that whether the population be of

mixed age constitution (as found in the approach to village conditions of living of the free labourer) or be solely of the mature ages of both sexes indentured for labour, the mortality rate records are, as held in the Report, as good as obtained in " any civilized city in Europe " :—

	Birth-rate per 1,000 persons living.	Death-rate per 1,000 persons living.
Free on Estates ..	50·3	14·4
Indentured on Estates ..	....	9·6

Evidently, the estates which secured the major parts of these reductions in mortality and sickness of expensive labourers must have found that sanitation is a paying investment.

The Surgeon General concludes the Report with the following significant assertion: " Attention to the prevention of disease is urgently required in British Guiana, and possibly in no other colony can the direct benefit of remedial measures be so easily and so readily accomplished."

Gibraltar (1914).*

The Annual Report of the Sanitary Commissioners of Gibraltar for 1914 is written by Lt. Col. G. Dansey-Browning, R.A.M.C. This opens with information as to the physical characteristics of the Rock. He shows that it has an altitude of 1,408 feet above sea level at its highest point, and is 2½ miles long with a total acreage of 2⅙ miles. The town occupies a little over 104 acres; so that, obviously, the great importance of Gibraltar to the Empire is not with reference to its acres.

The Civil population at the Census of 1911 was 18,036. The people live largely in buildings of the type common in Southern Spain; that is, they are " built round a central courtyard or patio not infrequently covered in by a glass roof." This form subserves neither perflation nor the requirements of conservancy. The limited space at disposal has brought about an extraordinary density of population, 137·54 persons per acre equivalent to 88,025 persons per square mile. It is therefore a foregone conclusion that to maintain the health of such a population, subject to possible importation of disease from adjacent and independent Spanish territory, demands no mean sanitary alertness. That the administration has been successful, is shown by the crude death-rate being 14·97 against 16·17 of the previous year—the corrected death-rate for 1914 being 17·62 per mille.

Conservancy is of a mixed type. Whilst the central-northern parts are provided with sewerage arranged for the water carriage system, " the military quarters at Catalan Bay are served for liquid excrement only. Public pail closet latrines are provided for the Civil habitation whose liquid excrement and sullage water is disposed of by being thrown into the sea, or allowed to soak into the ground." Lt. Col. Dansey-Browning places this description of existing defects on record

* Annual Report of the Sanitary Commissioners on the Health of Gibraltar for the Year 1914. [Medical Officer of Health, G. Dansey-Browning.] 8 pp. 1915. Gibraltar: Garrison Library Printing Dept.

without remark; and, as the whole Report bespeaks a keen appreciation of sanitary facts, it may be assumed that this silence is eloquent of hopes deferred, owing to "want of funds."

The water for drinking purposes is derived from rainfed tanks. The average rainfall for the last 12 years is 33·33 inches. This tank supply was supplemented in 1914 by distillation of sea-water, owing to the rainfall being less than the average and the greater demand by ships. Sea water is supplied by pipes by pumping from the sea. This is used for general sanitary purposes and, irrespective of the convenience, has had a beneficent effect in getting rid of "small domestic tanks," which, again, it is hoped will diminish mosquito prevalence.

Seven cases of typhoid fever occurred during the year. One of these was "in the case of an English lady, on a visit to Gibraltar, who partook of a meal at an inn at Los Barrios where the cook was suffering from the disease."

In detailing measures undertaken in cases of typhoid, Lt. Col. Dansey-Browning states that the useful precaution is taken of providing anti-typhoid vaccine for the protection of contacts. He follows up this statement by showing that more than 50 per cent. of cases of enteric fevers found in Gibraltar have apparently been contracted in the neighbouring districts of Spain and, consequently, advises those who for business or pleasure proceed thither should be protected by anti-typhoid inoculation.

Only three cases of undulant fever occurred, a fact that the Report contrasts with results at Malta where, in the financial year 1913–14, there were 338 cases and 25 deaths from this disease. These three cases were not traceable to goats supplying Gibraltar. Not only is routine bacteriological examination of the goats conducted but vendors are legally responsible that the milk is *boiled*, and this order also applies to the milk received from the neighbouring parts of Spain. In one instance the cook of a restaurant sacrificed himself to an impelling sense of duty! He was required to boil the milk before it was issued, but "drank a glass of raw milk daily on its arrival to ascertain whether it was fit for sale."

Tuberculosis yielded a death-rate of 2·37 per mille of the population. In notified cases of this disease, the influence of environment is thus illustrated:—

Persons inhabiting	one room	tenements	..	24	cases.
,,	,,	two	,,	,,	..	6	,,
,,	,,	three	,,	,,	..	8	,,
,,	,,	four	,,	,,	..	4	,,

The Rock possesses a "Tuberculosis Home and a Destitute Sick Fund." By these means not only is treatment afforded the tuberculous, but their necessitous dependants are aided and possible tuberculosis is searched for amongst them.

Assam Jails.

In illustration of sanitary possibilities in India, the great reduction in mortality which has followed Applied Hygiene in British and Native Troops is often quoted. But the fact that a very great reduction in the mortality of jails has also been secured, is none the less noteworthy.

The troops are a picked body of men in the prime of life under discipline, but without the mental handicap of imprisonment, and resident in carefully selected surroundings, with the benefit not only of sufficient but of variety of food. Indian prisoners, on the other hand, are ordinarily mentally and physically of lower types and of mixed ages and sex, who have been subjected prior to their conviction, to diseases and dietetic vicissitudes common to a civil population, in the midst of improving but still poor hygienic surroundings. In the Bengal Presidency, in 1861, the death-rate amongst prisoners was 96·7 per mille, whilst in Bengal proper and Assam it was 87·7 per mille. In 1900-04, in all India, the average rate had decreased to 25, and in 1905–09 to 24 per mille. In 1911, the rate for all India was 18·44; in 1912, 16·74; and in 1913, 16·56 per mille. These figures are the more creditable, in view of the fact that there are still in use buildings that are not in accord with modern ideas of hygiene, and with water supplies and surroundings which do not fail to turn the balance towards preventible mortality.

But, in "the land of regrets," the criminal is not the first or only charge upon public funds, and the total average is depreciated by a few marked exceptions. Thus, the fortunately small population of the Assam jails, according to the Report for 1914, shows the following heavy mortality rates per mille from 1911 to 1914, 54·36; 36·10; 40·87; 43·53. In the jail of Sylhet, where 33 deaths occurred, 50 per cent. were due to dysentery. The Inspector General of Prisons, Assam, makes the following remarks on the subject* :—

"In connection with the subject of dysentery I issued instructions to all Superintendents to administer Manson's mixture to all new admissions so as to estimate the amount of ankylostome infection and to deal with it. Where the figures can be relied upon, the results show that there is a considerable proportion of the free population infected, amounting to 49 per cent. in Gauhati and 44·70 per cent. in Dibrugarh. It is curious that the Sibsagar sub-jail should show a percentage of 22·72, whilst Jorhat shows ·56 and Nowgong 3·45, but I am not sure that the latter figures are accurate."

The population of the Gauhati jail (mortality 52·49 per mille) is thus described :—

"This is another jail with a large incidence of dysentery cases. . . . Noticing the high case-mortality in our jails, I issued instructions in May last directing that no patient was to be placed under observation for more than 24 hours, and that if after that period he was unfit to do work he was to be admitted to hospital. It appears that until the receipt of these instructions a large number of cases had been treated in this jail as observation cases, the duration of this observation extending to as many as 42 days.

"At my inspection I have been struck with the poor condition of prisoners on admission to this jail, which can be easily understood when we find that 49 per cent. of them are infected with the *Ankylostoma duodenale* and 17 per cent. addicted to opium and ganja."

Quinine was given as a prophylactic in 15 grain doses to all prisoners from May to October. In one jail the Superintendent gave 10 grain doses three times weekly, "on the ground that prisoners could not stand the larger doses." Of 369 cases of malaria fever admitted for treatment, 254 occurred during the period of prophylaxis.

*Report of the Jail Administration of the Province of Assam, 1914. p. 12.

DISEASE PREVENTION.

Malaria.

Major Anti-malarial Works.

Hongkong. During 1913, 18,140 dollars were spent in continuing the effort of training the nullahs as an anti-malarial work. Up to the end of 1913, nullahs have been trained and cement channels have been laid down to the extent of 11·6 miles. Twenty-one qualified British whole time Sanitary Inspectors are employed, and include in their routine duty oiling of pools and minor sanitary and anti-malarial works. The population of the Colony fluctuates greatly in ordinary times, but this was markedly so in 1911, 1912 and 1913, when some 40,000 to 50,000 refugees, in connection with political disturbances, entered the Colony. The following figures exhibit the influence of the still incomplete works. The fluctuation in result with troops is necessarily open to the interpretation of "depending on the healthiness or otherwise of the last station occupied by the troops."

Admissions to hospital per mille :—

Years.	British troops.	Indian troops.
1909	138·4	54·3
1910	177	89·8
1911	125·5	31·8
1912	84	83·2
1913	42·5	83·9

In regard to the general population, subject to the wide fluctuation in numbers stated, as might be expected the results are not so marked ; but the influence is unmistakable.

The deaths from malaria per mille of the general population were in 1909, 1·2 ; 1910, 1·7 ; 1911, 0·9 ; 1912, 1·1 ; 1913, 0·7.

Malaya. During 1913, in Singapore, there was spent in dollars, for reclamation of swamps by filling and by drainage 10,000, for subsoil drainage of malarial swamps 10,000, for minor anti-malarial works 5,000 ; in Penang, for miscellaneous anti-malarial work of the same character, 83,497 ; and, in Malacca, for surface drainage 2,903.

Uganda. The drainage of swamps "in or adjacent to the stations of Kampala, Masindi, Hoima, Mbale and Bukakata was continued during the year [1914] and drainage of marsh land at Entebbe was begun."

Zanzibar. During 1913, a sum of Rs. 19,068 was spent in drainage work "on two areas which formerly were constant anopheline distributing centres." A further sum of Rs. 10,000 was sanctioned for further drainage work during 1914.

Southern Nigeria. "In routine reclamation and drainage £4,239 was spent in 1913."

St. Kitts Nevis (total population 42,279) spent £100 under this head.

Mauritius. Anti-malarial works of a permanent character are being undertaken over the whole island, costing Rs. 1,000,000 approximately. A sum of Rs. 150,000 is annually provided for this purpose. Evidently here the object lesson of drainage in the vicinity of the Phoenix Barracks, as advised by Sir Ronald Ross, has not been forgotten. The nature of the works is thus described :—

"A general anti-malarial campaign has been started and works of a permanent character carried out, particularly in the districts of Pamplemousses, Flacq and Black River. Rivers are being canalized and cleaned, marshes reclaimed, and objectionable collections of stagnant water removed. Works of a minor character continue to be carried on, such as filling of canals, trenches, upkeep of permanent works, etc."

During 1914, Jamaica spent £3,661, approximately, upon—reclamation of swamp land of Kingston, Pen, Port Antonio, Warner's Pond Swamp, St. Ann's Bay, Thornton Swamp ; and upon concrete drains in Kingston, Portland, St. Mary, St. Ann, St. James, Hanover, Westmoreland, St. Elizabeth, Clarendon and St. Catherine.

The above facts are culled from the Official Returns, in the form of replies to queries, as recorded in the Report of the Advisory Committee for the Tropical Diseases Research Fund, 1914. More information as to progress would doubtless be available, were it not that the otherwise useful forms enjoined by the Colonial Office are differently interpreted by those concerned. In certain areas, Medical and Sanitary expenditure are lumped together, and no classification of expenditure on the latter account is given.

Rhodesia.

In Southern Rhodesia, during 1914, there were 569 Europeans and 169 natives admitted to hospitals on account of malaria, against 779 Europeans and 241 natives in the previous year. The mortality for Europeans was 0·53 per cent. and for natives 4·73. The reduction of malaria is due to small rainfall during the previous wet season. At the same time, it is hoped that already the visit by General Gorgas and Sir Patrick Manson is exhibiting influence. Much anti-malarial literature has been issued "in tabloid form" to settlers at cost price. Chemists, storekeepers, post offices and certain Native Commissioners' offices have been utilized for sale of quinine, and it is hoped to include railway stations. These arrangements "have been largely taken advantage of." It is reported that in spite of the decrease in malaria, there was no marked fall in the blackwater fevers admitted to hospitals this year.

Sierra Leone.

In his "Annual Report on the Medical Department for 1914 (Sierra Leone)" the Principal Medical Officer, Dr. Rice, states that in Freetown 1,027 cases of malaria were treated, and that of 282 diagnoses made microscopically the parasites were found in the following variety and proportion :—

Subtertian	74·5 per cent.
Quartan	20·2 ,, ,,
Benign	0·69 ,, ,,
Mixed	4·6 ,, ,,

Formosa.

The Japanese in Formosa promptly recognised that to get rid of malaria would be a "scientific conquest, which will make great contributions towards the development of the rich Island of the Far East."* As a preliminary, certain areas were selected for experiment, chiefly in the direction of quinine administered to proved malaria parasite bearers. They were selected as follows :—

"All the inhabitants and sojourners in the locality are summoned up *en masse* on a day appointed (once a month in general) and by means of an ear-lap-piqure of everybody, a thin blood film preparation is made, which is, after staining with diluted Giemsa's stain, subjected to microscopical examination for malaria-parasites. The parasite-carriers thus discovered are compulsorily administered Quinine preparation, after Nocht's or modified calender. They are placed under such medical treatment for 30 days during two months, so that the parasites shall be practically exterminated. The preparation is Hydrochlorate of Quinine in tablet (0·2 gram) Euchinin powder (for children and some special cases) and Esanopheles pills (for Splenomegaly); and these are given gratis under strict control of police officials."

In this way, 396,621 people were examined, of whom 11,396 were found to be "bearers," and were treated with quinine accordingly.

The following is an abstract of the table given by the author showing results secured :—

The Death and Malaria Death-rate in some Localities before and after the Work commenced.

		Chikutoki.	Ako.	Karenko.	Bokusek-kaku.
Preceding Year.	Population	—	5,000	2,500	1,000
	Death-rate	—	35·80	38·40	34·00
	Malaria death-rate	—	5·00	11·60	15·00
1 Year	Average Population	1,870	5,400	2,836	1,001
	Death-rate	48·13	35·00	41·60	27·98
	Malaria death-rate	—	—	6·34	—
2 Year	Average Population	1,652	5,997	3,537	1,215
	Death-rate	45·9	39·7	31·66	23·78
	Malaria death-rate	0·6	—	3·39	—

Crab-holes and Mosquito Breeding.

Dr. W. E. Giblin, in the Annual Report for Papua, 1913–14, states though there is no evidence of malaria as yet in the Samarai Island, anophelines are there ready to perform their function. He states :—

"I have frequently searched for their breeding places, and at last have been rewarded by finding some larvae within a few feet of my front door.

*Hatori—Antimalarial Campaign in Formosa.—*Far East. Assoc. Trop. Med. C. R. Trois Congrès Biennal. Saigon,* 1913 (1914). p. 501.

Heavy rains had caused the ground water to rise and flood several crab holes; larvae were found in the entrance to several of these holes. Apparently during the dry weather the larvae recede into the holes with the descent of the water, and there lie dormant until conditions again become favourable for their growth and pupation. This supposition seems quite probable, as in captivity the growth of larvae may remain stationary for many weeks if conditions are unsuitable."

Fish Larvicides in Wells.

Whilst the utility of stocking wells with fish is duly acknowledged as a useful anti-malarial measure, statistics showing results of their action are difficult of attainment. Dr. K. RAGAVENDRA RAO, Special Malaria Officer, Madras City Corporation (in a Report embodied in Madras G. O. N. 937 M., 25th June 1915), makes a useful appreciation of facts. Apparently, no exact estimate of the proportion of larvae-bearing wells before commencement of operations was available. As the Report extends over the period from September 1913 to January 1915, the question of seasonal influence may, perhaps, be put aside. The reporting officer is at least well justified in claiming the results as "encouraging":—

"The introduction of these larvicidal fish into wells, etc., was started in September 1913 as an experimental measure and an amount of Rs. 4,000 has been spent and the operation is being continued, the men working now at Georgetown. I am making an investigation into the efficacy of this measure and so far I can say it is an encouraging one. Whereas almost every well examined before the introduction of fish for mosquito larvae was credited with a positive result, only 72 of 788 wells examined subsequently or 9·25 per cent. were found to contain anopheles larvae. The following table makes the point clear:—

"Total number of wells examined, 788. Number in which fish were dead, 108. Number of wells in which anophelene larvae were present, 72 or 9·25 per cent. Remarks.—The larvae have been found in wells where fish were alive.

"Fish have till now been introduced in nearly 8,000 wells.

"Here again we are confronted with one difficulty and that is in some cases, especially where the wells are filthy and disused, the fish introduced die out soon, and it requires careful watching of every well from time to time to see that the fish introduced continue to live. To this end it is proposed to retain an establishment of one maistry and ten fishermen whose sole duty it is to continue the operation over the whole town and at the same time, reintroduce the fish where they are once put in and where they may die."

Silt.

The economical disposal of silt confronts both the sanitarian and the engineer—the latter more especially in respect to the working of irrigation canals, and the former as to change of configuration of land and diversion of streams with attendant malaria propagation. The agricultural benefits of silt depend very much upon the nature of the silt, and the time of its arrival on the land; whilst it can be but rarely that the engineer is rid of trouble as to silting of his irrigation canals and channels, even if a scheme for disposal were to benefit the agriculturist. Natural lakes of extraordinary depths at times fulfil the function of arresting silt successfully, but silting reservoirs, other than for waterworks (when prompt removal is effected), have not been much employed for the purpose. An article by the Consulting

Engineer, United States Reclamation Service (Louis C. HILL),* shows that the Colorado River is so loaded with silt that the headworks of the irrigation canals are liable to fill up, and the natural stream beds tend to be so raised as to endanger the flooding of town areas.

The remedy proposed is of a radical character. It is calculated that at a certain point "the silt in suspension equals $1\frac{1}{8}$ per cent. by weight of the river volume." In a compact mass, the silt weighs from lbs. 75 to lbs. 80 per cubic foot. A dam on this river is to be "first built 318 ft. high from foundation to parapet wall, but the gates and other structures are designed so as to permit increasing the height by 40 or 50 feet, thus increasing the capacity by 3,000,000 acre-feet, which additional capacity would provide storage for all the silt brought down in 250 or 300 years. Later more expensive reservoir sites could be developed, or the dam raised still higher, extending the life of the project indefinitely."

It is reckoned that "the cost of providing silt storage on this basis would not exceed 4/100 cent. (four-tenths of a mill†) per cubic yard."

It is therefore possible that at times it may be cheaper to afford such storage for silt than to encounter the recurring expense for keeping irrigation canals clear, and then to pay landowners for storage room near the banks! The whole subject is of great importance in respect to land reclamation and anti-malarial measures in areas subjected to irrigation.

Oil Films.

Exactly how much oil is required to make a satisfactory film has an interest in the economics of anti-mosquito measures. Certain experiments by Professor Henri DEVAUX (Faculty of Sciences, Bordeaux) incidentally throw a light on the subject. In a paper embodied in the Annual Report of the Smithsonian Institution for 1913, he explains how he arrives at the thickness of a film of oil. He made a standard solution of pure oleine in benzol, so that in the pipette employed by him one drop would be equivalent to $\frac{1}{50,000}$ of a cubic centimetre of oil. He found that two drops of oil on water spread so as to give an area of 363·71 square centimetres: therefore, he reckons that the thickness of the film was $\frac{V}{S} = \frac{400 \times 10^7}{363 \cdot 71} = 1 \cdot 10$ mm. with an approximation between 1·04 and 1·15 mm.

YELLOW FEVER.

Shanghai.

Dr. Arthur STANLEY, Municipal Health Officer, Shanghai, in his Annual Report for 1914, gives the following opinion as to the possibilities of invasion by yellow fever:—

"The opening of the Panama Canal brings nearer the possibility of yellow fever coming to China, especially if vessels come direct from infected

* Engineering Record, 1914, Dec. 5.

† Mill = one-tenth of a cent, U.S. money.

ports in the Gulf of Mexico and other places. If introduced to China, it is likely to spread on account of the prevalence of the *Stegomyia scutellaris* mosquito which is closely allied to the *Stegomyia fasciata*, the known carrier of yellow fever. There is now greater need than ever for anti-mosquito measures in Shanghai."

The Philippines.

The following is the opinion of Surgeon HEISER* as to yellow fever possibilities :—

"In addition to the serious danger which constantly threatens the Philippines on account of their close proximity to thickly populated centres in which quarantinable disease is always more or less present in epidemic form, there will be the additional menace of yellow fever being conveyed by vessels that pass through the Panama Canal. While it is not likely that yellow fever will exist to any appreciable extent in the Canal Zone, yet its presence in contiguous territory and at ports of call at which such vessels are likely to stop constitutes a source of danger to the Philippines. The introduction of yellow fever into the Philippines would be a great calamity because of the presence and very wide distribution of a mosquito, which apparently is the same as the one which acts as the intermediate host in other countries. The *Aedes* (*Stegomyia*) *calopus* has been greatly reduced in numbers by the anti-mosquito campaign which has been conducted in Manila during the past few years, but when these efforts are slightly relaxed they soon reappear in large numbers."

VOMITING SICKNESS.

Whether or not vomiting sickness is a form of yellow fever is an important matter which has long been disputed. Dr. Harold SCOTT, Government Pathologist, Jamaica, thus gives his opinion on the subject :—

"1. That the weight of evidence is against the disease being due to a bacteriaemia.

"2. That the rapidity of progress of symptoms with early fatal termination (or, in rarer instances, rapid and complete recovery) rather indicate the action of a poison.

"3. That, in view of the early symptoms being gastric, and the cerebral succeeding soon after, this poison is produced in and absorbed from the stomach ; (the gastric and duodenal congestion present tend to support this).

. . . . . .

"The only suggestion I can offer as to the source of this hypothetical poison is that, since one can never obtain any history to implicate any particular article of food, it is due to something which is apparently dangerous only at certain times of the year, some fruit, perhaps, or vegetable, or what, in my opinion, is more probable, some growth (fungus, yeast, mould, etc.) on or in this food, rendering it toxic.

"The disease rarely attacks adults, as it would if it were due to ordinary food poisoning ; it almost never attacks the infant in arms, but it attacks mainly those at the toddling age (75 per cent. this year) ; amongst the poorer natives the children get the minimum of attention, and there is every opportunity for them to pick up unripe, or otherwise unsuitable, food from the ground and eat it, without their parents even being aware that they have done so."†

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* Annual Report U.S. Public Health Service, 1914. p. 149.

† Report of the Advisory Committee for the Tropical Diseases Research Fund for the Year 1914. p. 230.

Kala Azar.

A Supplement to the Sanitary Report of the Province of Assam, 1913, has been published, which contains the results of kala azar surveys by Major F. McCombie Young, I.M.S. (Deputy Sanitary Commissioner, Assam) and Major Bodley Scott (Civil Surgeon, Sylhet) respectively. The object held in view was not research as to nature of the disease (concerning which a special officer has been deputed for duty—Major Mackie, I.M.S.) but to ascertain the limits of Assam actually infected. The former reports that in the area allotted to him he visited all the districts said to be infected, and verified the existence of kala azar "by splenic puncture of selected cases." Care was taken not to employ the method more than essential, lest, by producing unpopularity of the operation, future preventive measures might be prejudiced. The following method, as suggested by Major Mackie, was that employed :—

"An all-glass hypodermic syringe, with several needles, was sterilised before going out for the day. A bottle of tinct. iodi. and one of liquid carbolic acid was carried, and a box of carefully cleansed slides.

"When the confidence of the villagers had been obtained, in the course of palpation of spleens with the patients recumbent, tinct. iodi. was applied to the skin over the spleens of all examined. In a selected case with a hard spleen and no evidence of excessive blood deterioration, a drop of carbolic acid was also rubbed into the skin over the area for puncture. When the skin over this area had become somewhat numb, a sterilised needle, carefully concealed in the hollow of the left hand, was rapidly plunged into the spleen and the patient's attention attracted elsewhere, while my assistant rapidly fitted the syringe to the needle, withdrew a drop or two of fluid and made the films. In most cases the puncture was thus accomplished without the patient being aware of any unusual proceeding. The patient was always cautioned to lie down for the rest of the day, and a dose of calcium chloride administered before leaving. In this way punctures were performed with as little fuss as possible, and no bad results occurred."

In differentiating cases of malaria from kala azar, on clinical grounds, Major McCombie Young states :—

"I noted that, if towards the end of the cold weather one found a family of two or three children suffering from enlarged spleen with a history of infection during the preceding hot weather, and with a history of improvement of health in all cases instead of deterioration, one might assume that the infection was malaria and not *kala-azar*, in which disease the general tendency is towards death and not towards recovery."

As to sex incidence, he found only 31·2 per cent. were females but suspects error on account of the greater timidity of female children. Of the cases seen 76·6 per cent. were 20 years of age. 87·2 per cent. were persons engaged in agriculture ; but he places no stress on this fact, as the majority of the people in the area examined are so employed. Similarly figures gained as to caste of those infected could not be utilized satisfactorily, without an analysis of castes in the area ; but he considers the extent of infection of the Kacharis in Mongaldai within areas named by him worthy of note. A previous history of infection in the family of infected persons was found in 50·1 per cent. In 61·5 per cent. of cases the houses were situated in "light jungle" ; 30·5 per cent. were near running water, and 8·9 per cent. near tanks ; 40·1 per cent. got water from wells, 20·6 per cent. from tanks and 34·0 per cent. from running water.

"74·4 per cent. of infected families possess cattle, 51·0 per cent. keep fowls, 42·7 per cent. keep dogs, 37·2 per cent. cats, then follow pigs, goats and pigeons in a decreasing ratio. The comparatively small number of infected families which keep dogs seems to indicate that the dog is not concerned with the propagation of the disease in Assam, and this observation is in line with the research work of Donovan and Patton in Madras."

This analysis, whilst conveying much of value, says nothing as to method of conservancy, condition or nature of habitation, methods of clothes washing and bathing, of possible sources of contamination of water supplies, peculiarities of food and habits in connection therewith, or of entomological circumstances.

By contrasting the past histories of epidemics in areas examined and their present condition, Major McCombie Young is able to establish the fact that epidemic waves, after lapse of considerable periods, leave the country practically free of the disease. On this subject he states :—

"The reason why the disease should have persisted in certain areas, and should have more or less died out of others in which during the epidemic years it was equally active, is a curious epidemiological fact that requires explanation. There is no apparent reason why this should be so, and the fact that determines it may be one of the factors in the causation of the disease at present unknown, or unproved. Possibly further research in those areas may discover this factor. . . . The almost complete disappearance of the disease except in a scattered sporadic form is noteworthy when the past records of the disease in this district are examined, and it is interesting to note that in the tract of country in which it first appeared within the jurisdiction of Assam administration, it is now almost absent. Can a racial immunity have been acquired in the 50–60 years which seem to have elapsed since its first appearance ?"

Major McCombie Young's recommendations as to prevention are founded upon the belief that the disease is originally started in an area by the importation of an infected person. He thus expresses his views :—

"An area gets infected by importation. The infection spreads and a panic is established. Infected families who have lost one or two of their number and see others dying, decide to migrate elsewhere to an uninfected area. They do so, if unchecked, taking with them an infected person, or the seeds of the disease. This leads to the propagation of the disease in this area and the process then repeats itself. The people themselves are well acquainted with this and will often refuse to allow an infected family to enter their village, or to permit a member of an infected family to enter another by marriage."

Thereupon he suggests a scheme for keeping the people under surveillance by means of travelling dispensaries (distinct from those dealing with general curative measures) under the control of the Sanitary Department.

As regards the Sylhet District the enquiry conducted by Major Bodley Scott, independently of Major McCombie Young, also supports the opinion that the importation of an infected human being is the first step in an epidemic. The following are extracts from his Report :—

"The cases have been found very definitely localised in distinct foci. Certain villages or small groups of villages within a thana are infected and have in most cases been infected for several years, while the neighbouring villages are free. Within a village the infection is localised in one or two houses or in certain rows of houses, where again it is found to have existed for long periods, the surrounding houses escaping. The spread from one village to another and even from one house to another seems to be a very slow process."

"A single case within a household was found to be a very rare occurrence. Almost invariably one member of the family after another had developed the disease and this process had in very many cases continued until the whole family was carried off. . . . Jaldhup contains the largest number of kala-azar patients. There is an old focus of the disease in this thana affecting a compact group of villages around Tilpara dispensary, which is known to have existed for the last 12 years. I shall refer to its history again. I visited the place in February 1912, made spleen punctures, and saw many cases of kala-azar and plain evidence of the ravages of the disease. Rows of deserted '*baris*' (houses) or abandoned dwelling sites were to be seen where whole families were reported to have been gradually carried off by kala-azar. Though the disease shows little tendency to die out, it has remained localised in this small group of villages for years and does not seem inclined to spread into the surrounding neighbourhood. . . . It may be remarked that all these lie in country which goes under water for half the year, when each village is a small island and the inhabitants lead a semi-marine existence."

Spleen Punctures in Diagnosis.

Puncturing the spleen, although largely conducted with safety, is a method in diagnosis which many would gladly dispense with as far as possible—more especially the subject observed. Dr. C. M. WENYON* states :—

"On a case of kala azar which was in the Albert Dock Hospital, under the care of Dr. Sandwith, I was able to test the possibility of culturing leishmania from peripheral blood. Six tubes of N.N.N. medium were inoculated each with two or three drops of blood obtained by pricking the finger of the patient. Eighteen days later there was a culture of flagellates in each of five of the tubes which were not contaminated with bacteria. The culture method may thus be employed as a means of diagnosis in this disease and it is a method which is not so distasteful to the patient as either spleen or liver puncture."

DYSENTERY AND DIARRHOEA.

Somali Diarrhoea.

In Somaliland the milkman is not content with economising his supply of milk by the use of water; according to Dr. PAGET, Senior Medical Officer of the Protectorate, there is practised an unusual adulteration of camel's milk :—

"Another group of cases comes directly under the heading of direct malicious intent. These are the adulteration of camel milk with the white extremely irritant juice of euphorbia trees. Milk diluted with water to which the above vegetable sap is added is not easy of recognition by the lactometer. In every case severe vomiting and purging result, frequently to a dangerous degree. The difficulties in securing the offenders is often great, as during part of the year the supply of fresh milk is hard to obtain on the coast anywhere. If, as has not infrequently occurred, the milk is needed for sick Europeans or is supplied to the hospitals for sick Indian troops, the offenders are often assisted to escape recognition. Commandeered milk, for however urgent a purpose, is under local conditions always very risky, no price seeming to influence attempted malicious adulteration."†

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* Report to the Advisory Committee, Tropical Diseases Research Fund, 1914, p. 93.

† Somaliland Annual Medical Report for 1914. (Received in Colonial Office, June 15, 1915).

A vaccinator in another part of the tropics, pressed for a supply of vaccine, has been known to substitute the irritating juice of this adaptable plant for the genuine material.

Flies and Bowel Affections.

In the Report of the Surgeon General, British Guiana, for 1914, it is stated that in the Almshouse and Orphan Asylum having an average of 775 inmates, efforts to reduce the prevalence of flies by various methods, especially the use of the formalin spray, "have been efficacious. The numbers of cases of diarrhoea and dysentery have been reduced to half and the deaths to one-quarter of the average for the previous four years."

Dysentery and Liver Abscess.

To those readers of Section 1 (European Army) of the Annual Report of the Sanitary Commissioner with the Government of India for 1913 who have reminiscences of Netley, the mention of Secunderabad of "dysenteric notoriety," in para 17, will bring back memories of a much respected veteran teacher who has joined the majority. That this place in spite of sanitary advance should, according to the Report, yield "a larger number of cases than any other station" is of interest having regard to its previous history. It is further asserted that this station has also yielded the largest number of cases of abscess of the liver.

"The essential cause of the prevalence of dysentery could not be ascertained; every probable source of origin was investigated and a weekly inspection of all cooks, sweepers and followers generally, in the hope of finding "carriers," was made without success. All cases were treated with hydrochloride of emetin (half a grain twice daily) hypodermically. . . The most marked characteristics in connection with this year's reports on dysentery has been the success following the use of hydrochloride of emetin administered hypodermically in the amoebic type of the disease and the remarkable reduction in the number of hepatic abscess cases."

Surgeon General MACLEAN taught that the use of ipecacuanha in dysentery diminished the chances of hepatic abscess. In the official Report on the health of British troops in the Madras Presidency for 1873, the following references occur: "Dysentery specially yielded to ipecacuanha in 1859 and should not be forgotten. . . . The prompt and early treatment of dysentery therefore appears, so far as we can see at present, to be the most certain means of diminishing the losses of the Army by hepatic abscess." Obviously the pioneers of that period with the means at disposal drew correct inferences which, thanks to Sir Leonard ROGERS's valuable work in the light of later science, have been proved to be correct.

The diminution of hepatic abscess with less incidence of dysentery is thus stated :—

Year.	Ratio per 1,000.			
	Dysentery.		Liver Abscess.	
	Admissions.	Deaths.	Admissions.	Deaths.
1909	11·2	·25	1·4	·43
1910	7·7	·23	1·0	·48
1911	7·7	·26	1·0	·46
1912	5·2	·15	1·7	·32
1913	5·4	·11	·5	·20

A search for the particular source of infection by the *Entamoeba histolytica* at Trimulgherry might well repay special effort by the Indian Research Fund. The persistence of a pathogenic agent, such as shown in this area, should facilitate the discovery of the necessary conditions.

Plague.

Plague Factors.

The flea has occupied so great a place in reference to plague that the suggestion that other agencies may bring about transfer of the *B. pestis* is generally put aside by the statement that, whilst theoretically possible, they are of little or no epidemiological importance. Yet to the practical sanitarian, whilst to devise methods to meet the flea and its bearer is essential, the neglect of minor possibilities of infection might imply waste of both energy and money upon the major cause. In this spirit, the Medical Inspector, Sanitary Bureau, Government of Formosa (Dr. Kuraoka) urges that whilst to the flea the pride of place must be yielded, other factors cannot be safely ignored. At the Saigon Conference* he stated that from personal examination of 40 patients he found in 25 per cent. "such slight wounds as scratches, stings and ulcers(non plague) which might with good reason be looked upon as the possible passages for the plague bacillus." In 1896–9, at the Taihoku Infectious Diseases Hospital, of 229 patients 28·83 per cent. had wounds on the bodies. In 1900 at Taihoku and Tainan, of 734 patients (24·66 per cent.) the same could be said.

"When plague, contracted through invisible wounds, pneumonic plague abruptly occurring during the prevalence of bubonic plague without being preceded by plague pneumonic cases, tonsilar plague, and cervical plague, which is apparently contracted through the mouth, be added to the list the percentages will be markedly raised. Then through what agencies have the rest of patients been infected with the plague bacillus forms a final question to be explained. . . . In short, though I believe

*Far East. Assoc. Trop. Med. C. R. Trois. Congrès Biennal, Saigon, 1913 (1914), p. 204.

that conveyance of plague from rat to man is largely effected by rat-fleas, particularly by *Loemopsylla cheopis*, yet it is absurd to charge them with the whole responsibility. . . . I am of opinion that at least one-third, perhaps more than that, of human cases are caused by contact with inorganic matter contaminated with the plague bacillus."

Control of Rats.

Dr. Francis Clarke, Medical Officer of Health, Hong Kong, placed before the Sanitary Board a Memorandum, in which after pointing out that systematic poisoning of rats, house cleaning, the filling up of rat runs, the use of gratings and other measures have been adopted, he declared there was no reason to believe any permanent decrease of the rat population had been secured. He holds that "the only feasible method of limiting their numbers is to limit the food supply available for them; this consists mainly of the waste food from dwellings, markets, factories, etc., and rats will enter houses at night to search for food and will also feed in the yards and lanes surrounding them if garbage is to be found there." He stated that the Sanitary Board had adopted rulings as to storage of garbage in covered bins, and that various efforts towards rat proofing had been made, but the success depended upon the cooperation of householders which was not at present of the necessary energy. He would therefore put aside direct methods of attack upon rats and would advise as follows :—"All our efforts and all the efforts of the community should be concentrated upon the speedy removal of refuse of all kinds from the precincts of dwellings and offices, and no measure which will help to exclude rats from these premises should be neglected." The Governments of both Burma and Mysore have already abandoned the direct crusade against rats, in favour of methods such as are suggested in Dr. Francis Clarke's Memorandum.

Spread of Plague by Rats.

Surgeon R. H. Creel, United States Health Service, has recently published the result of an interesting experiment conducted by him on migration of rats in connection with plague spread.* He quotes the Indian Plague Commission's statement in the *Journal of Hygiene*† as showing that with English writers the question is held to be of negligible importance and that they had "observed nothing to show that rats are in the habit of migrating, *e.g.*, from one quarter of the City (Bombay) to another."

He marked 179 rats on the ear, so as not to be over conspicuous to their fellow rats. Trapping was ceased for ten days in the area from which they were taken, but was allowed to progress in the rest of the City of Orleans. On the expiry of this period, the rats were let loose at midnight. Ten were found dead at the end of twenty-four hours, within a short distance of the point at which they were released; in 48 hours, nine more were found dead. He considers "these had died from injuries incident to their captivity." But, between 48 to 60 hours "one half-grown *norvegicus*" was found about one mile away.

*U.S. Public Health Reps., 1915, June 4, p. 1679.
†1907. Vol. 7, pp. 886, 907, 947.

Within two weeks "a number of rats were retaken from points four miles distant from the site where they had been released in a residential part of the city."

A second lot of 113 marked rats was then released in the wholesale provision warehouse district, where plenty of food and good shelter were available. Surgeon Creel states, "whereas 40 rats of the 160 from the first series (this number excluding the 19 dead found near point of liberation) made wide spread excursions, only 8 from the second series (113) made any extensive travel." The different opportunity for food and harborage in the two sites where the respective batches were liberated "was assumed to be sufficient reason for difference of migration." Surgeon Creel then applies the moral of his experiments as follows :—

"The practical bearing of this study upon epidemiologic considerations of plague is very apparent. Had these rats at time of release been in the very earliest stage of the incubative period of plague there can be no doubt that their excursions would have been similar, though for shorter distances. That a spread of the epizootic would have resulted by a series of 'relay' rodents seems only too probable. Quite frequently in an infected community isolated cases of human and rodent plague are found well removed from any other known focus of infection. The irregular travel of rats sufficiently accounts for this and explains the broad stretches of presumably non-infected territory between foci. As early as 1906, Thomson in Australia noted this extension of infection 'per saltum', but offered no explanation for the phenomena."

If Surgeon Creel implies that if an infected rat be introduced with merchandize into a city it may travel in the way indicated, the writer would agree with him. But this is quite a different matter to discussing spread of plague from one point to another in the same town, by means of the original rat inhabitants of a particular area. Besides the sufficiency of food and available shelter, the rats Surgeon Creel liberated must have had to consider or actually experience the doubtful welcome likely to be given by rats in possession, they being notoriously devoted to "scraps" in more than one sense.

A rat let loose in the residential quarter would be more likely to come in contact with rats determined to protect their scant resources than would be the case in the wholesale provision area. Hence the greater or less effort to secure a near home. Even if a rat were liberated near his old home, the chances of his being received amicably by his late harem might be small. Instead of the evidence pointing to spread by habits of migration, it might equally well be interpreted as showing strenuous tribal discipline requiring the stranger or the discredited and returned captive to "move on." In epidemics in India nothing can be more definitely marked than the prolonged period during which rat infection may be limited to small areas. In prevention of disease spread, the point at issue is of importance in deciding the value of "observation staffs" on special duty, in advance of plague infection of communities. Granted a failure to detect importation, such staffs on the spot have yet another hope of preventing general spread, by prompt and radical effort in such areas. To accept the view that a "residential" rat is, under normal circumstances, liable to "irregular travel" to the extent of two miles per week, would imply a wholesale scattering of infection which is contrary to general experience.

The following is an extract from a published official Report by the writer (April 1903) :—

"In the matter of infection of rats, I have always maintained that unless infected rats be actually imported alive in a locality—as may happen in bales of merchandise—or become infected in the locality by imported material, they do not *originate* plague by extending from an infected to a healthy area, except in cases where the places are very close to each other. To endeavour to arrive at some conclusion as to the extent to which infected rats spread from the original point of introduction of plague (Nalbund Lane) I caused Certificated Sanitary Inspector Pranathartihara Aiyar to prepare the accompanying plan, showing the outside limits at which dead or supposed infected rats were found."

This diagram showed that the limit of infected rats, notwithstanding continuity of streets, did not extend beyond half a mile from the original point of infection, although an epidemic period of five months had elapsed. Further experience on the subject was, in an Official Report published in 1905, thus expressed by the writer :—

"I accept as a working hypothesis that rats live in clans. They probably have their own limits of haunts, and have methods of government. They appreciate the fact that residence in some localities may be undesirable. If the food supply becomes insufficient, or deaths from diseases or malicious poisoning by man be frequent, it is realised it is time to 'clear out.' Consequently, whether rats are poisoned, or attacked by plague, or other diseases they will seek safety in flight. The crucial point is how far do they flee. I believe this can only be answered by stating that they do not flee one yard further than they are obliged, having regard to previous occupation of the nearest healthy area by another clan of rats, the amount of food available and freedom from worry by man, disease, or poisoning; and that whilst in towns, if plague accompanies them, they may from time to time move and thus increase the area of their influence in spreading plague, it is unlikely any single migration ever extends beyond half a mile at a time."*

Nevertheless, Surgeon Creel's experiments certainly usefully indicate the possibility of an infected rat imported in merchandise, by rail or sea, escaping from the site where first dumped, finding itself without welcome by rats in the proximity, and of necessity wandering to distant points in the interests of self preservation. A "Wanderlust" by instinct, as suggested by Surgeon Creel, as well doubtless as the writer's hypothesis, requires further proof.

Cholera.

Zanzibar Jail.

In 1912, there was an outbreak of cholera in the Zanzibar Jail. In a population of 115, there were 42 attacks with 22 deaths. The exact mode of introduction could not be traced. From August 5th to the 10th there were 31 cases. Two iron drums containing water were used in the cells—one for drinking, the other for ablution after defaecation. There was reason to believe they were used indifferently. The prisoners were removed to Quarantine Island on the 9th August.

* See also suggestive evidence by Professor Boycott, Sanitation Number of this *Bulletin*. Vol. 4. p. 205.

The drums were then locked and provided with taps. Captain D. T. SKELTON,* R.A.M.C., states :—

"But even this precaution did not stop the disease entirely. I then adopted the plan of making each man wash his hands in a strong solution of carbolic after he had been to the latrine. As a warder accompanies a prisoner on these occasions it was made a matter of discipline that the warder should see this order carried out. Further every prisoner before being given his food was compelled to wash his hands in a large sufuria of strong carbolic. These extra washing precautions were only brought into force on the 21st and the effect became apparent, because between August 21st and August 30th there were no further cases of cholera. I have recently learnt that in an epidemic of cholera in a jail in Manilla the authorities were unable to stamp it out until these washing precautions were adopted. This is an interesting fact."

Whilst the importance of hand washing is thus evident, the writer thinks it is probable that during cholera prevalence in jails using certain forms of latrines, the desirability of like attention to the feet after visiting a latrine should be held in mind. Equally, the particular care of men detailed to remove the vomit and excreta of the *first* and perhaps dubious cases is requisite. The writer has known an epidemic in a jail and a lunatic asylum, respectively, in which what might have proved a more or less solitary case was the cause of an epidemic, by the person removing the vomit and excreta of the first attack contaminating exposed water supplies, not conserved for drinking but used surreptitiously. In both cases, the cholera vibrio was identified and the mode of contamination of the water was clearly proved.

Cases under treatment in hospital in Zanzibar for cholera were not discharged until it was proved that the cholera vibrio was to be found in neither smears nor cultures. "The longest period in which it was found that vibrios persisted was 21 days."

Philippines.

In the Philippines, no quarantine for sea-borne traffic was imposed during 1914 against cholera. "Reliance was placed principally upon the detection of cholera vibrios in the stools of passengers from suspected ports." Isolation of the sick and disinfection of stools and vomited matters were carried out, and the proper disposal of human excrement in all the towns in which cholera appeared. "Cholera often appeared in towns in which no connection with the previous cases could possibly be traced, and it was not an infrequent experience to find cholera vibrios among residents of towns in which no cholera appeared later."†

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*Annual Report of the Public Health Department, Zanzibar Government for the year 1912, p. 33.

†Annual Report U.S. Public Health Service, 1914, p. 146.

Age Incidence.

The following is the distribution, in age periods, of cholera in the epidemic of Zanzibar during 1912 :—

	Oct.	Nov.	Dec.	Total.
1 to 5 years	..	9	9	18
5 to 10 ,, ...	..	15	1	16
10 to 20 ,, ...	1	11	2	14
20 to 30 ,, ...	10	45	15	70
30 to 40 ,, ...	3	48	21	72
40 to 50 ,, ...	6	28	10	44
50 to 60 ,, ...	4	19	13	36
60 to 70 ,, ...	..	11	6	17
70 to 80 ,, ...	3	10	5	18
Over 80 ,, ...	..	25	11	36
Unknown age	1	101	..	102
Total..	28	322	93	443

The following calculation is given as to incidence upon the population of each age in 1,000 attacks in the Madras Sanitary Commissioner's Report for 1895 (para. 103), from which it would appear that the chance of escape of the suckled infant is greater than at other ages :—

Under 1 year of age	0·3
,, 1–5	·6
,, 5–10	·6
,, 10–15	·5
,, 15–20	·6
,, 30–40	·6
,, 40–50	·7
,, 50–60	·8
,, 60 and over	·5

Cattle and Cholera.

Professor W. J. Simpson, C.M.G., in his paper "War and Cholera" read before the Society of Tropical Medicine and Hygiene* made the following observations :—

"But comma bacilli were not confined to the waters of the Hooghly or Tolly's Nullah, or the canal in the suburbs of Calcutta, or to tanks or drains. I had frequently observed a marked coincidence between outbreaks of cholera with diarrhoeal disease among calves in the neighbourhood of tanks. This led us† to examine cows and calves suffering from diarrhoea in the vicinity of cholera outbreaks, with the result that commas were found in the intestines of fatal cases, especially of calves. We also found comma bacilli in the cesspools connected with the cowsheds in which animals were suffering. The exact connection of these commas to cholera in man we had no opportunity of determining."

* Trans. Soc. Trop. Med. & Hyg. 1915. Vol. 8. No. 5, p. 148.

† [Haffkine and Simpson.]

The intimate connection of the bulk of the people with cattle, and of the cattle with the water supplies of the people, dictate the desirability of this subject being fully investigated.

TUBERCULOSIS.

Tuberculosis amongst Indians.

The necessity for contending against tuberculosis as one of the causes of excessive mortality in India has, of late years, received considerable attention from medical officers, and in this direction private philanthropy has been successfully appealed to. It is however far from a recent factor in mortality. Dr. CHANDRA SEKAR, Assistant Professor of Hygiene, Medical College, Madras, has in a paper published in the "South Indian Association Journal" done good service in calling the attention of the people of the Madras Presidency to the increasing, but still incompletely recognized, danger of spread of tuberculosis. In the following interesting introduction to his paper, he shows that the disease was recognised by the Physicians of ancient India:—

"Distinct reference is made to this disease, which is known as Raja Yakshma, in the Hindu Vedas revealed about 3000 B.C. The god of the moon is stated to have suffered from this complaint as the result of a curse for disobedience to his father-in-law, and excessive attachment to his wife, Rohini. Kalidasa (6th Century A.D.) related in the last chapter of his Raghuvamsa that Agnimitra, the last of the line of Raghus, suffered from consumption and died of it. . . . Susruta (4th Century A.D.) calls it the 'Big disease' with many complications and many premonitory symptoms, which is difficult to diagnose, and difficult to treat. He notes loss of appetite, fever, dyspnoea, cough, haemoptysis, alteration of the voice, drooping of the shoulders, retraction of the chest, fever, burning sensation in the body, diarrhoea, and heaviness in the head amongst the symptoms of this disease. Susruta as well as Madhava advise physicians to avoid the cases with cough, anorexia, fever, diarrhoea, pain in the sides, and alteration of the voice; and the cases with haemotysis, fever and cough. Both these physicians were aware of the bad prognosis in intestinal and laryngeal tuberculosis, and had a justifiable dread of the cases with haemoptysis."

In adverting to the prevalence of tuberculosis in Madras City, Dr. Chandra Sekar shows that in a five years' average, 1907–11, there were found tuberculosis lesions in 13·51 per cent. of the total bodies examined in the Madras General Hospital. The disease is by no means one for which the people as yet largely resort to European treatment, but the figures for the hospitals in the Presidency show a steady increase. Thus, in 1901, the Surgeon General's Report shows 7,456 cases of tuberculosis treated, and in 1910 these amounted to nearly 14,000. In the City of Madras, the admissions for treatment amounted to 1,249 in 1910; using a "morbidity factor" based on percentage of the people resorting to hospital Dr. Chandra Sekar considers that the city contains no less than 8,746 cases. He, on these figures, urges energetic action before this pest makes further spread.

The Sanitary Commissioner for Madras in his Inspection Notes of the Madras City for 1894 (W. G. KING) asserted that when registration was better effected, it would probably be found that tuberculosis was an important item in cases classed under "fevers." If the morbidity factor now excogitated by Dr. Chandra Sekar were applied to the

General Hospital admissions at that period there were then only 1,256 cases in the City. There has therefore occurred considerable increase in the interval, showing that Dr. Chandra Sekar's warning deserves attention.

It may be safely said that for many years past it has been customary in all Indian jails to segregate cases of tubercle of the lung, and to treat sputa with full care.* There is no reason to believe that, in the presence of these special efforts, residence in jail conduces materially to contraction of the disease. Hence, making allowance for the fact that criminals are ordinarily representative of the lower classes of a community, the following figures supplied by the Report of the Sanitary Commissioner with the Government of India for 1913 are of some utility, in showing the probable comparative degree of prevalence of tuberculosis in the various Provinces, and in supporting the action of philanthropists and sanitarians who are pressing the subject upon public notice :—

Rates per mille of Strength of Admissions and Deaths of Prisoners for Tubercle of Lung during 1913.

Provinces.	Average strength.	Admissions.	Deaths.
Burma	16,748	6·6	4·0
Assam	1,672	9·0	2·39
Bengal	11,273	12·2	3·10
Bihar and Orissa.. ..	6,697	9·1	3·14
United Provinces.. ..	21,822	4·4	1·56
Punjab	12,906	23·6	5·80
N.W. Frontier Provinces..	2,008	9·0	1·99
Central Provinces ..	3,581	7·8	3·07
Bombay	9,728	4·0	1·44
Madras	9,178	6·6	1·74
Andamans	11,541	3·8	3·47
Total in India ..	108,286	8·6	2·99

Bovine Tuberculosis in India

In 1903, in a published communication, the writer reported on this subject to the Government of Madras, as follows :—

" It is a subject that I have borne in mind for several years in connection with this Presidency ; but although personally of opinion that there must exist tuberculous disease among bovines, I have neither myself nor from enquiries from others been able to secure evidence on this point. . . . In the previous year [1900] I also sent out circulars promising the supply of tuberculin to all medical officers finding suspicious cases, without however obtaining any positive results. Finally, I have before now writing to you asked for the opinion of the Head of the Civil Veterinary Department. He informs me that he ' has seen no cases in Madras.' "

* In certain of the Administrations, the question of special Tuberculosis Jails is under consideration. In his Report for 1913 the Inspector General of Prisons, Bengal, Lt.-Col. W. J. Buchanan, C.I.E., thus alludes to the subject:—"The need of a special tuberculosis jail is as urgent as ever, but the prospect of getting it seems as far away as ever."

In Burma also, in 1908, the Head of the Veterinary Department gave the opinion to the writer that the disease was very rare. There is, however, a concurrence of opinion amongst Veterinary Officers that cases at times are found amongst foreign imported and half-breed animals.

The subject of bovine tuberculosis was, in 1912, investigated in the Bombay Bacteriological Laboratory.* Tests of 101 samples of milk and of 50 carcases yielded no signs of tubercle. A qualified Veterinary Inspector, in charge of a slaughter-house in Bombay, is quoted as stating that although 150 animals are daily slaughtered no tuberculosis lesions were found. On the other hand, the Director (Major LISTON, C.I.E.) refers to a "recent experience in Cawnpore, where in 2,000 cattle slaughtered 3 per cent. were stated to have suffered from tubercle." Unfortunately, by whom this experience was gained and whether verified bacterioscopically is not stated.

So far then it would appear that there are large areas in India where bovine tuberculosis is practically unknown. That being so, in the light of the position of bovine tuberculosis assigned to it by the Royal Commission, it would seem most desirable that the full facts as to limitation should be ascertained. The Civil Veterinary Department is being largely expanded and, in certain Provinces, there should be little difficulty in ascertaining precisely where the disease exists, and whether the importation of cattle is sufficiently rare to justify a legal ruling requiring the passing of the tuberculin test.

The peril of spread of bovine tuberculosis in India would be considerable as, although the boiling of milk is with the Hindu a universal procedure, the use of cowdung for smearing floors (according to SHIPLEY a good procedure against fleas) and for certain purification ceremonies (including internal administration to human beings) is commonly pursued. The making of cow dung cakes for fuel is also universal in rural tracts—the process entailing much handling. The farmer practically lives with his cattle—his desire being that when he wakes from sleep this animal, which means so much to him in agriculture and religion, shall first greet him. Granting then bovine tuberculosis may exhibit itself in lesions in man other than pulmonary, there can be no doubt that check of opportunities of spread of this form of the disease in animals *whilst still rare* would be of great advantage in the interest of both man and beast.

Whilst areas where bovine tuberculosis exists could be recognized, the task of eradication would, in some Provinces, be beset with political pitfalls. An area being proved to be infected, it might be possible by legal measures to prevent transfer of animals. But whatever the extent of public action considered advisable, it is evident that the various societies recently formed for contending with tuberculosis in the human being in India, would be well advised not to omit bovine tuberculosis from consideration.† The proof brought forward by the Bombay Bacteriological Laboratory that the disease is rare is an admirable reason for early action.

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* Report of the Bombay Bacteriological Laboratory for 1912, p. 25.

† Burma has recently adopted a method that might be expanded for this purpose, and, by placing the matter in the hands of owners of cattle, avoid the "pitfalls" alluded to. Here a "Mutual Insurance Society" undertakes the insurances of cattle, and encourages measures against epizootics which include anti-rinderpest inoculation.

Race Incidence.

"The Seventh Report of the British Guiana Society for the Prevention and Treatment of Tuberculosis" shows that its energetic efforts are not undergoing diminution with lapse of time. The local medical staff have given their labour gratuitously, and lady visitors have done much towards feeding necessitous cases and improving the hygiene of their surroundings. The Report affords an analysis of 1,089 patients. The following are the results as to race :—

669	were	of the	Black	race	and	of these	58	or 8·6	per cent.	were	tuberculous.
209	,,	,,	mixed	,,	,,	,,	16	,, 7·6	,,	,,	,,
110	,,	,,	East Indian	,,	,,	,,	9	,, 8·1	,,	,,	,,
86	,,	,,	Portuguese	,,	,,	,,	9	,, 10·4	,,	,,	,,
15	,,	,,	other races	,,	,,	,,	2	,, 13·3	,,	,,	,,

The following is an extract from a Review of pathological records by the Board of Health Laboratory Panama Canal, during the month of May 1914* :—

"Contrary to the belief that tuberculosis is less common in the Tropics than in other climates, this review shows that the disease is common on the Isthmus, and that it is increasing among the negroes. Its clinical course in these negroes can be better represented by months rather than by years, as is the case in members of the white race. The disease becomes more often widely disseminated in the negro than in the white race.

"Instances of arrested or healed foci in the negro are far less frequent than in the white race. Pulmonary tuberculosis becoming widely disseminated is the common type of the disease in these people. Bone, joint, and cutaneous tuberculosis is far less common among negroes and mestizos of the Isthmus than in the white race. . . . . Where permanent colonization of the Tropics takes place and business association brings together the various races, tuberculosis will no doubt be as important an economic factor as it is in the temperate climates."

Passed Assistant Surgeon E. Smeet, U.S.A., writing in the U.S. Public Health Reports of April 23, 1915, gives the following opinion :—

"The Mexicans are possessed of an extremely low racial immunity, which is probably due to the large admixture of Indian blood. Their resistance has never been developed, because they have never fought the infection through successive generations. Just as in children the susceptibility decreases as age increases, so in races the further removed they are from civilization the more susceptible they are to the disease. The type of the infection clearly proves this, for in each of the races cited the process is diffuse, identical to that witnessed in childhood. The soil is of far greater importance than the seed, and an unestablished immunity more to be considered than the presence of consumptives."

Small-pox.

In Chattanooga, Tennessee, cases of virulent small-pox have been reported.† Up to January 15 of this year there had been 56 cases with a mortality of 28·6 per cent. Most of the cases have been of the

* Report of the Department of Health of the Panama Canal Zone for May, 1915, p. 8.

† U.S. Public Health Reps., 1915. Jan. 29, p. 328.

haemorrhagic or confluent type. As there is a present day tendency to believe that small-pox as a virulent disease is not found, the following description of one of the cases is reproduced :—

"The patient had been sick three days with initial symptoms of a chill, severe headache, and backache. The attending physician had treated him for influenza. Until the day of his death no eruption had developed, but on the morning of January 15th ecchymoses and petechiae began to appear, and shortly afterwards he had severe hematuria, and died at noon. The body presented no evidence of macular or papular eruption. It was very frankly a case of purpura variolosa."

Bacteria-free vaccine.

The *Medical Record* (New York) of May 1st, 1915, published a paper by Dr. HIDEYO NOGUCHI, working in the Laboratories of the Rockefeller Institute, in which he proposes a new method of propagating a pure vaccine virus. After referring to the technique at present employed for getting rid of extraneous organisms, he points out that much labour and care could be avoided were it possible to devise a means by which "the virus can be propagated directly free from bacterial contamination." This, he declares, has been realized by transmission of virus which has been subjected to successive inoculations of the testicles of the rabbit. The essential first step is the securing of vaccine "quite free of bacteria."

He considers this can be obtained " . . . by inoculating the carefully cleansed and shaved skin of the rabbit with glycerinated virus, protecting the vaccinated surface with sterile gauze, collecting the skin vaccine at the height of the eruption, and, spores and spore-bearing bacteria having been thus excluded, emulsifying it in sterile salt solution and treating the emulsion with pure ether or with phenol in appropriate concentration. Non-spore-bearing bacteria may thus be killed without seriously impairing the strength of the virus. Vaccine virus containing bacteria is unsuitable for testicular inoculation, since the inflammation which ensues favours the growth of the bacteria at the expense of the virus."

Vaccine thus prepared multiplies in the testicles of the rabbit much as it does in the skin, and produces typical vaccine vesicles on the human being free of inflammation due to invading bacteria. He however warns that only by successive attempts and selection can there be finally secured a strain that can be transmitted regularly from generation to generation in the rabbit, and that this difficulty is also found in repeated adaptation of the strains to the calf. In the latter case, the testicles of the bull calf are used in the same manner as those of the rabbit. A full account of his experiments is published in the *Journal of Experimental Medicine.* 1915. Vol. 21. No. 6. p. 539.

Tetanus after Vaccination.

ROSENAU in experiments conducted with glycerinized vaccine stated as to tetanus spores that "very small amounts may remain active for months." Such statements are apt to be interpreted by the public not as a demonstration of the limits of bactericidal action of glycerine, but as an admission that such contamination of vaccine is no uncommon matter. The subject has undergone very careful examination by Dr. John ANDERSON, Director, Hygienic Laboratory U.S.A. Public Health Service. He shows* that when the rhesus monkey and guinea-pig (both animals susceptible alike to vaccination and to tetanus) have

* U.S. Public Health Reps., 1915. July 16, p. 2112.

been experimentally inoculated with anti-small-pox vaccine, "heavily contaminated with the tetanus spores," there resulted the usual course of successful vaccine without symptoms of tetanus. He states that enough vaccine for 2,000,000 persons has passed through the laboratory, and in no case has the organism of tetanus been detected although specially searched for. Enough vaccine has been issued in the United States for 40,000,000 subjects, and as 31,900,000 doses of the issued material were not returned, it is fair to suppose that 31,000,000 were vaccinated with it. In this large number, only 41 authenticated cases of tetanus were found. When the histories of these cases were fully investigated and the date of operation and supervention of tetanus were definitely ascertained, Dr. Anderson found that in tetanus following vaccination "the average period from vaccination to onset of symptoms is 20·7 days while the average mortality is 75·2 per cent." and that this high mortality rate is similar to that in cases of tetanus with an incubation of ten days or less. He then points to the fact that the vaccination scab begins to form on or about the tenth day, and that it was found that in many of the cases the scabs had been prematurely removed. He concludes as follows :—"Cases of tetanus occurring 15 or 20 days subsequent to vaccination do not receive their infection through the vaccine virus, but in all probability the infection is received about the tenth day or later after vaccination. The infection with tetanus is received by a contamination of the vaccination wound, such as may occur in the infection of any other surgical wound not properly cared for." No explanation is afforded by Dr. Anderson as to why in his experiments on monkeys and guinea-pigs, when using vaccine purposely contaminated with tetanus spores, no inimical result followed. Surely here is involved some useful fact connected with glycerine, vaccine or the combination.

Age Incidence.

A table supplied by Dr. H. C. Highet, P.M.O., Siam Government, shows how greatly in a population poorly protected by infantile vaccination small-pox is responsible for deaths of the young and that a diminution of mortality occurs as age advances. It may be safely assumed this has been secured by immunity acquired by attacks of small-pox. The figures supplied are :—

Ages at death from Smallpox.

Age.	Sex.		Total.	Rate per cent.
	Male.	Female.		
Under 3 months ..	34	32	66	2·7
3 months to 1 year ..	277	293	570	24·0
1 to 5 years	367	349	716	30·2
5 to 10 ,, ...	120	125	245	10·3
10 to 20 ,, ...	222	132	354	15·0
20 to 25 ,, ...	142	64	206	8·7
25 to 35 ,, ...	125	48	173	7·3
35 to 45 ,, ...	20	6	26	1·0
45 to 55 ,, ...	6	1	7	..
55 to 75 ,, ...	0	1	1	0·5
Unknown	3	1	4	..
	1316	1052	2368	

Craw-Craw or Smallpox?

The following observation is made by Dr. R. H. KENNAN, Senior Medical Officer, Sierra Leone, in his Annual Report on the Medical Department for 1914:—

"Clinical descriptions have appeared elsewhere of a condition described under the rather makeshift name 'acute crawcraw.' Further experience enables little to be added to those descriptions, but has confirmed the view that it is important from the public health point of view that the condition should be more widely known and recognised. Successful vaccination up to the end of the second day of the rash is possible in some cases of smallpox, but after that time it is not known that vaccination has been successful within a period measured by years. In 'acute crawcraw' cases, however, which have not been previously vaccinated, vaccination 'takes' normally at any time. The test of course will not distinguish between 'acute crawcraw' and varicella, but the differential diagnosis between these two is of minor importance. It is suggested that all cases diagnosed as sporadic discrete small-pox or suspected of being such, should be tested by vaccination."*

WATER

Emergency Disinfection of Water.

Permanganate of potash, which has been largely trusted to for disinfection of water supplies in cholera epidemics, is just now very expensive and an official substitute is desirable. In the various expeditions in the tropics by our troops, the question of rapid purification of water against water-borne diseases must also have, at the present time, special significance.

The use of lime hypochlorite for water disinfection has long been practised. In America, 600 cities employ it in their water works as a routine measure. Its mutability, especially under tropical conditions, is, however, an impediment to its extensive use. Captain J. J. HARPER NELSON, I.M.S. in the *British Medical Journal* (1915, May 8th) has advocated a method for generating chlorine gas, as required, by using apparatus that he considers is readily portable, and he shows how useful the method has been in practice. On the other hand, Captain NESFIELD, I.M.S., who has long given attention to modes of chemical purification of water, in the *R.A.M.C. Journal* (February, 1915), calls attention to liquified chlorine as a useful agent. He states:—"I have had ten chlorine cylinders with me for the last nine years in India; they have travelled many thousands of miles by rail and road without an accident. The cylinders I recommend contain 10 lb. of liquid Cl, weigh about 20 lb., and stand 3 feet high on their own base." Major LELEAN, R.A.M.C., in his admirable work "Sanitation in War" states as follows:—"The use of chlorine led to various suggestions which have been aptly described as 'fantastic.' One was the use of metal cylinders of the compressed gas. . . . Such proposals need but be mentioned to be dismissed as impracticable in the field." Major Lelean would apparently consider for service reasons chlorinated lime as preferable. However this may be, it is evident that Captain Nesfield's evidence as to cylinders kept with him nine years in a tropical

* "Annual Medical Report for 1909 and Annals of Tropical Medicine, 1910. Mar. Vol. 3. No. 5."

climate, and subjected to the risks of transport by rail and road many thousand miles, should go to show absence of corrosion and sufficient strength to withstand shocks. As usually sold and accepted for shipment (the latter being a good test of opinion as to safety) the cylinders are 52 inches in height and contain 100 lb. liquid chlorine. The gross weight is 185 lb., and therefore within the load of a pack horse. Simple attachments permit of control of flow of the gas.

The writer suggests that it is probable there is scope for use of both hypochlorite of lime and liquified chlorine. The doling out of the hypochlorite might be convenient in treating the contents of such receptacles as water carts, or small sources of water supply at numerous separate localities, in areas where the securing of fresh quantities of this chemical is feasible; but when distance, facility of transport and large water-supplies are factors, the liquid chlorine should have distinct advantages.

In a paper read before the American Water Works Association by Francis D. West, Chemist, Torresdale Laboratories*, both the advantages and disadvantages of liquid chlorine as against chlorinated lime are set forth. It is held that liquid chlorine will retain its full efficiency over unlimited time, whereas hypochlorite of lime deteriorates; that the floor space for storage of material for the latter method is greater than for the former; that the amount of hypochlorite that will give a taste to water may be estimated at from 20 lb. per million gallons; that the average figure will be from 10 lb. to 12 lb.; this would mean 2 lb. of liquid chlorine; that a heavy over-dose can be given without complaint; that the feed of liquid chlorine is more uniform than with the hypochlorite process; that in general the cost of the two processes should be about equal; if anything liquid chlorine should be cheaper.

The following are the objections to liquid chlorine:—"The chief objection to the use of liquid chlorine lies in the concentrated energy of the material itself. If liquid chlorine is set free in small enclosures, it will cause nausea. With ordinary common sense and judgment on the part of the operator this is not likely to happen. The greatest danger lies in faulty cylinders and faulty valves. If the cylinder valve will not turn off or if the cylinder leaks it must be got out to the open air and the chlorine allowed to escape."

Careful inspections of cylinders and valves must be made. Liquid chlorine when it comes in contact with moisture has a very corrosive action, but this has been overcome by the use of hard-rubber pipes and towers. Mr. West concludes his paper as follows:—

"While in some instances liquid chlorine may prove more costly than chloride of lime, the regularity with which it can be applied, its more effective action on pathogenic bacteria, the small compact apparatus and the absence of the odour of chlorine around the plant recommend it as a satisfactory substitute for hypochlorite, having, as it does, all the advantages of the latter and only some of the faults."

Emergency Lime Hypochlorite Apparatus.

Perhaps the most readily adaptable machinery for disinfection of water by hypochlorite of lime is that prescribed by the Ontario Provincial Board of Health. They advise as a method readily understood

* Engineering Record. 1914. May 23, p. 584.

by the people, a teacup to be filled with lime hypochlorite and this amount to be mixed with three teacupfuls of water. One teaspoonful of this mixture is to be added to each two gallons of water to be treated, the water to be allowed to stand ten minutes before use.

But the Minnesota State Board of Health have devised a simple and readily portable apparatus for dealing with a public water supply of 1,000,000 to 4,000,000 gallons per day.* It is assumed that at the locality concerned there can be obtained three sound 50 gallon barrels. The entire apparatus which is used in conjunction with the barrel can be placed in a trunk for shipment. The articles to be conveyed are :—

"One chemical feed box, one float valve, one control valve, one collapsible mixing device, four ½-inch brass grate valves, eleven ½ by 3-inch iron nipples, two ½-inch iron tees, 12 feet of ¾-inch rubber garden hose, and one 10-pound can of calcium hypochlorite, or 'bleach.' This constitutes the entire equipment necessary to set up the plant and put it into operation, exclusive of the barrels and stand. The weight of the trunk and contents complete is 67 pounds."

For field service there is added to this equipment portable bacteriological and chemical outfit packed in neat portable trunks, bringing the entire weight up to 162 lb.

Ultra-Violet Rays.

Indian Engineering† (Calcutta) in an article referring to a paper in the Journal of the Franklin Institute gives the following results of experiments with ultra-violet rays :—

". . . In testing the comparative effect on different kinds of germs, it appeared that their resistivity did not vary so much under the action of ultra-violet rays as under the action of either heat or disinfectants. . . . The abiotic action of a mercury vapour lamp is independent of the temperature between zero and 55° C., beyond which the power increases greatly with lamp temperature ; in other words, a lamp sends out more ultra-violet rays the hotter it is ; but care has to be taken not to raise the temperature unduly, because then the quartz becomes opaque and the passing of the rays is seriously interfered with. As an approximate result arrived at by experiment, it may be stated that the luminous tube of the lamp will not absorb more than 25 per cent. of the ultra-violet light after 3,000 hours, if run at a temperature not exceeding about 700° C. If run above 800° C. the tube becomes very opaque to the rays. Considering next the water under treatment, it is necessary for it to be free from suspended and colloidal matter, that is to say, it must be clear to enable the rays to traverse it. If quite clear it is as permeable by the rays as air is. . . . At Luneville, France, is an installation with a ten-lamp canal which has practically banished typhoid from the city, and there are now several large plants of the same type under construction in the country. The energy required is found to vary between 50 and 130 units per million gallons of water, allowing for very large safety co-efficients."

Having regard to the necessity of rendering the water clear in the first place, it is not likely that ultra-violet rays can be of much utility under war conditions, except at a base. In the Morocco campaign, however, a portable equipment consisting of a water pump, filter and gasoline motor generator was placed on a gun carriage. "In the field hospital where it was used not one case of hospital infection broke out, nor was there a single case of typhoid or dysentery."‡

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* U.S. Public Health Reps., 1915, Feb. 26, p. 616.

† 1915. Feb. 13, p. 103.

‡ Engineering Record, 1913, August 2, p. 121.

Search for Potable Waters.

The following extract enforces the necessity for a careful weighing of all facts as to physical formation of areas and of soil and subsoil conditions, to enable any judgment to be arrived at as to selection of subsoil sources of water supply. The finding of a fresh water supply at small depths within the area of wave action on a coast, incident to certain physical conditions, is by no means unknown elsewhere. Dr. McHattie thus states the result of what must have implied much laborious work by him :—

"In forming an opinion as to the purity of the well water little weight has been given to the Chlorine figure which in many cases is extraordinarily high owing probably to the presence of pockets of salt in the rock. An attempt was made to find the normal chlorine content of the wells in a given district which might be taken as a standard but the variations proved to be quite bewildering. The chlorine content of 50 wells, all within an area of roughly half of a mile in length and two hundred yards in breadth, showed variations ranging from 12 to as much as 290 parts per 100,000. The chlorine figures for four of these wells, all apparently similar and subject to similar influences, within less than fifty yards of one another were respectively 205, 85, 62, 50. These variations are of considerable interest and are of great importance in relation to water supply as it seems almost impossible to foretell whether any given boring will yield fresh or brackish water. It is a remarkable fact that in certain places the freshest water is to be obtained practically on the sea shore, as is the case at Harbour Island."*

Bacterial Standards of Water Purity.

In his work on the Bacteriology of Surface Water in the Tropics Major Clemesha, I.M.S., has made a good case for the necessity of recognizing the particular kinds of faecal bacteria as contrasted with groups, as a guide to recent and remote contamination of water. On this subject,† Major McCombie Young, I.M.S., (in collaboration with Asst. Surgeon Ram Taran Sen, L.M.S.), makes the following remarks, consequent upon his examination of a water supply which he holds was "neither polluted nor pollutable" :—

"The conclusions at which we arrive from weighing these facts are that the presence in water of Bacillus No. 7, B. Grimthal, B. Coscoroba, B. Cloacae, B. No. 109, and, with a less degree of certainty, of B. No. 36, has no reference to pollution or even to a remote pollution, as in this case they appear to be normal constituents of an unpolluted water. These organisms cannot be derived from the faeces of birds, as there is no means of access for birds in the enclosures of the springs. Whether they come from the gut of earth-dwelling insects, such as grubs or earth-worms, is hardly worth discussing. We therefore suggest that these organisms may be allowed to leave our court acquitted of the charge of being at any time implicated in the pollution of water.

"With all due deference to Major Clemesha's opinion in this connection, we would suggest that this series of analyses raises the question whether these organisms are not present in faeces because they are at first present in water, and not *vice versa.*"

Major McCombie Young gives grounds for believing that the artificial protection of the spring he refers to is complete, and then

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* Annual Report of Superintendent, Resident Surgeon and Matron of Bahamas General Hospital for 1914, p. 11.

† Supplement to the Sanitary Report of Assam for 1913, p. 38.

shows that for the water to reach its present point of discharge it must pass from a plateau which forms its collecting ground above Shillong, "through a minimum vertical distance of 700 ft. of rock and most of it obviously passes diagonally through about 1,000 ft. of rock before emerging. The catchment area of the water bearing stratum is devoid of human habitation and consists of reserved forests and open grass downs on which a few cattle are pastured."

The writer suggests that in the absence of a description of the nature of the rock and of a complete sanitary survey of the plateau, the statement that water probably passes *through* (implying that the passage is chiefly by pressure) rock does not suffice to prove that 500 or even 1,000 ft. travel deprives water of its contained organisms. Nor, indeed, without definition as to the nature of the rock, would it be safe to predict that the particular spring tested was derived wholly from the plateau in question. Under certain conditions of rock and soil distribution, artificial or natural, on a plateau as described, it might be possible to find a pool to which cattle resort and in which their herdsmen perform ablutions where the use of a little fluorescene might help to supply missing details.

The Kasi and Jumtia Hills, of which the Shillong site is a continuation, are of complex structure. There occur "metamorphic rock, gneiss, micaceous slate and quartz rock which have become greatly altered, disturbed and contorted" by the granite which they overlay. The Assam District Gazeteer treating of the Shillong site refers to "enormous deposits of limestone on the face of the hills." Irrespective of the fact that Shillong in 1897 was subjected to earthquakes which may have produced disturbance, there is room for suspicion that the normal rock formation is not such as to preclude the possibility of water passing through fissures and, in the case of the limestone rock, through routes which may have been formed by water contact.

Food.

Jail Diets.

In the Madras Presidency, the death-rate in a total jail population varying from 13,340 to 11,400 has shown steady improvement from 1909 to 1913 thus:—23·2; 14·5; 13·5; 11·6; 7·9 per mille. The last rate is pointed to as a record figure with justifiable satisfaction by the Inspector General of Prisons (Lt. Col. Macnamara, I.M.S.). In discussing the causes of improvement, he is disposed to assign it chiefly to the use of diet founded on the principles ably laid down by Major McCay, I.M.S.*:—

"As to how these improvements in the sick and death-rates were brought about, the causes are without question many. To begin with, the year past was, I believe, a fairly healthy one outside as well as inside jail walls, but setting aside this cause of variation, a large share of the improvement is, I think it will be conceded, due to causes operating solely within the department. We have improved in our sanitation generally, in our drainage, in our kitchens, in ventilation, in our latrines and in our methods of handling and distributing food, and last but not perhaps least, in having

* Report on the Administration of the Jails of the Madras Presidency. 1913, p. 13.

introduced a more health-maintaining dietary. It is not possible to apportion the degree of success attained to each particular innovation, nor is it necessary; suffice it to say that the results for the year show that they justify the measures taken. Last year was the first year that the new diet was in force throughout, in all jails and it is significant that it also should be the year, when for the first time, the mortality rate in the jails of this Presidency (or elsewhere) has fallen to single figures. That the new diet has been beneficial, will appear further on when the great reduction in bowel diseases comes under notice, because improvement is more likely to manifest itself in this direction under an appropriate diet than under any other class of disease. It is to be noted that the better state of health in 1913 was very general in almost all jails, which fact in itself would point to a common cause acting through them all."

At p. 6 he further explains the rôle of the new dietary :—

"The value of the new diet scales, from the chemical standpoint, is not improved by the change from ragi to rice, but whatever value they possess is due to the fact that the total quantity of food has been reduced in both dietaries and the nutritive properties are now better proportioned than they used to be. This naturally has led to a better all round state of health and (what to the uninitiated is perhaps paradoxical) to an improvement in body weight. Both experiment and observation show that weight can go up, by reducing a diet that is unnecessarily large and badly adjusted and it has been demonstrated that by increasing the cereal grain in a diet beyond a certain and economical quantity (the dal remaining constant), the result is that less nitrogen is absorbed both relatively and absolutely."

When, however, the proof of increased weight with reduced cereal diet is sought for (p. 16) it is not forthcoming :—

"Of the total number of convicts discharged during the year, 63·60 per cent. gained weight as compared with 68·55 in the preceding year. The proportion of prisoners who lost weight went up from 18·65 in 1912 to 20·29 per cent. in 1913, but the latter figure is not large. These variations are what might be expected from one year to another, and provided they are not considerable, are of no serious import."

Also whilst regarding a reduction of bowel affections as due to the revised rations, he makes the following important admissions :—

"Dysentery seems to pick out the jails where the kitchens are defective, and flies are allowed more access to food than they ought to be. With the advent of better kitchens and more suitable latrine arrangements, the disease should decline. . . . Many minor improvements were made in our kitchens and cooking apparatus during the year and, I believe, to these are to be attributed in no small degree the better health enjoyed, especially as regards reductions in bowel diseases. The present cry is new and fly-proof kitchens everywhere. Already we have a number of them and others are projected."

Nevertheless, the coincidence of the reduced dietary with the reduced mortality rate is so marked and the problem is of such importance that it would be desirable to defer judgment, till further discrimination of factors concerned is forthcoming. Lt. Col. MacNamara's huge experiment must at least establish some great truths in dietetics. This is the attitude assumed in the matter as concerns the Bengal Jails, by Lt. Col. W. J. Buchanan, C.I.E., Inspector General of Prisons :—

"I am in complete agreement with the conclusions so thoroughly worked out and arrived at in Major McCay's report, but theory and practice do not always agree. I have tried on a large scale Major McCay's diet, part rice and part wheat-atta, and I am sorry to say that though physiologically superior it is not popular; it does not give the desired feeling of repletion and *bien être*, it being less bulky. . . . It is becoming more in use, especially in western districts, but is certainly not popular. I still maintain we should go slowly; the dietetic habits of a community can only be wisely changed slowly."

On the scale against the influence of the revised diet being so largely responsible, must be placed the fact that the progressive decrease in mortality was very marked before the adoption of the dietary, namely, a reduction in 1910 to 14·5 per mille from 23·2 per mille in the previous year and, as shown by the remaining figures quoted above, the improvement was progressive. The fall to 11·6 in 1912 must be discounted by releases in 1911, in honour of the King's Delhi Durbar. Superintendents, if choice were allowed, would have largely advised release of the feeble. The decrease of the population from 13,340 in 1909 to 11,400 in 1913 also could not fail to have influence in the matter of the "air ration" per head. The admitted improvement under "all causes" of mortality, in any case, brings into prominence the fact that increased resistance to diseases brought about by suitable dietary is a somewhat different question to abolition of agencies for their conveyance.

Indeed, the factor of prevention of disease is brought into relief, as contrasted with improved resistance of a body of men, if it be stated that, in the Bihar and Orissa Jails (certain of which are not in structure ideal), there is employed a diet* more nearly fulfilling McCay's requirements. Here the mortality was from 1911 to 1913, 19·1, 17·5 and 19·6 per mille. Again, the diet of the Burma jails by no means meets McCay's requirements; yet during tenure of office by the late Col. Frenchman, C.I.E., the mortality in 1906 to 1908 inclusive was, in an average strength of 12,926, 13·96; 11·38; 13·14 per mille. Under his administration, kitchens were well protected from flies, all diarrhoea and dysenteric patients were segregated, their clothing disinfected, and their stools separately collected and incinerated. Quinine prophylaxis was systematic. Unless the trace of animal food and possible phosphatic compounds in the form of ngapi† (half oz. per diem) be of more importance than ascertained, the distinguishing feature in this diet is the absence of animal diet and liberality of vegetables; and instead of using one form of dhall (lentils) "ringing the changes" with various beans. In allowing 10 oz. of vegetables against 6 oz. permitted in Indian Jails, in the writer's opinion, the Burman derives an important advantage, as the Indian Jail allowance is so small that seasonal variation in nature of supply becomes of serious importance; so much so that he believes the first stage of falling off in health and weight of prisoners may frequently be traced to this cause. The faecal mass of Burman prisoners however‡ supports McCay's contentions as to bulk of waste material. The following is the hard labour diet employed in the Burma Jails during the period mentioned:—

Rice 24 oz., husked and winnowed.	Condiments $\frac{1}{8}$ oz.
Dal or beans 4 oz.	Gnapi $\frac{1}{2}$ oz.
Vegetables 10 oz.	Salt $\frac{1}{4}$ oz.
Oil $\frac{1}{2}$ oz.	

* Rice 12 oz., wheat 10 oz., per diem. Dal 6 oz., vegetables 6 oz. [Salt, condiments and oil are also issued daily, and antiscorbutics under a special rule.]

†A paste of fish which has been salted and subjected in bulk to a long process of compression.

‡ Footnote, p. 476 of this *Bulletin*, Sanitation Number, June 15, 1915.

The right proportioning of diet by McCay's method is largely of economic value. He shows that with less labour to the digestive organs, and with less bulk, not entailing wasteful excretion of nitrogen, a diet consistent with well-being could be formed that would cost less than has been adopted. Thus, he reckoned that, on the principles laid down by him, "on a basis of 16,000 prisoners in Bengal, from rice alone a saving of over three-quarters of a lac of rupees yearly would result."*

It is evident from the results secured in the Madras prisons, however, that whilst this saving may be possible in Bengal on a single article of diet, adaptation to local conditions elsewhere is an essential if successful economy is to be secured. The Madras Jail statistics fail to show economy by use of the revised dietary, as the total cost has increased from Rs. 35. 0. 9 per head per annum to Rs. 38. 7. 0. This, however, is probably largely due to an Order issued by the Government making a distinction between rice and dry grain eaters—a matter chiefly of sentiment. Even sentiment, however, does not cover the fact that the rice is purchased ready milled, instead of as paddy to be pounded by jail labour. It ought to be possible to disentangle the items, and arrive at a clear understanding as to the financial economy of McCay's suggestion.

In any case, the adjustment of McCay's dietary to the Madras Presidency would not require the use of rice for the ordinary hard labour prisoner—derived from a population five-sixths of which (Cornish) use dry grains as the staple article of diet.

As the question of dietaries in jails for Indians and natives has recently attracted attention in certain of our African Colonies, the revised scale of diet used during 1913 in Madras is given in detail :—

	Ounces daily.	Ounces weekly.
Cereal—		
† Ragi (*a*)	15	105
† Cholam or (*b*)	15	105
† Cumbu (*c*)	15	109
Rice	5	35
Pulse (dhall)	‡5	35
Vegetables	6	42
Oil	$\frac{1}{2}$	$3\frac{1}{2}$
Tamarind	$\frac{1}{2}$	$3\frac{1}{2}$
Salt	$\frac{3}{4}$	$5\frac{1}{4}$
Curry powder	$\frac{1}{4}$	1
Onions	$\frac{1}{2}$	$3\frac{1}{2}$

Note (1) 26 oz. of cumbu to be considered as equivalent to 25 oz. of ragi or cholam.

(2) Convict warders are given 20 oz. of rice daily instead of 20 oz. of mixed grains.

As the Madras male adult Indian in free life is accustomed to use about 24–26 oz. of dry grain as the foundation of his daily diet, it is

* One lakh at 1*s.* 4*d.* per rupee = £6,666.

† For definition of these grains see succeeding Note "Famine Diets."

‡ 2 oz. of which may be replaced thrice a week by 2 oz. of smoked or dried fish or 4 oz. of fresh fish.

obvious that in the matter of quantity (as remarked by Col. W. J. BUCHANAN, in the case of Bengal) there will result a feeling of vacuum in the interior economy of prisoners, which it will be difficult to persuade them is not akin to punitive measures.

Famine Diets.

It will be seen that in a foot note attached to the diet scale quoted in the preceding note the difference (chemically) in nutritive value of (*c*) cumbu (*Penicillaria spicata*), (*a*) ragi (*Eleusine coracana*), and (*b*) cholum (*Sorghum vulgare*) is allowed for. This method might have been carried further in differentiating the value of cholum and ragi—more especially in the apparently better digestibility of the former, and the difficulty of getting rid of a reasonable proportion of the husk in the latter. In diets regulated so as to ensure a correct proportion of constituents this may matter little, but the whole question of the comparative value of grain becomes of supreme importance under famine conditions. This is a matter where work such as fulfilled by McCAY could be continued with benefit both to the saving of life and funds in India. Famine conditions contemplate the exaction of labour suited to physical abilities, and the giving of wages that will obtain a certain amount of food at market prices based on grain. The amount over and above the bare grain, for condiments, legumes and vegetables, even if sufficient, is not likely to be applied in correct proportion by the labourer in the absence of the necessary "kultur." Those earning a small wage more especially will commit the sin against which McCAY protests, of filling the vacuum by a useless proportion of carbonaceous matter. Nevertheless, the Famine Code Rules lay down a certain weight of grain without differentiation of its nutritive value *so long as it is in common use in localities*, with the result that whilst in one part of India the famine labourer readily is kept in sound health in another, on the same allowance of grain, this is not feasible.

The following contrast of one of the Famine Code diets with different grains as a basis will illustrate that it is possible in localities using wheat to adopt the lowest scale of famine diet, and yet secure for the people almost as good nutrition as if employing a much higher scale. In this manner authorities responsible for famine administration in one part of India may be capable of using a low diet and exacting labour such as is impossible in another.

D. Diet = 16 oz. grain.

When wheat is used.				When cholum is used.				When ragi is used.			
Albuminoids.	Starch.	Oil.	Starch equivalents.	Albuminoids.	Starch.	Oil.	Starch equivalents.	Albuminoids.	Starch.	Oil.	Starch equivalents.
Oz.											
2·615	12·191	0·567	13·495	1·943	12·815	0·695	14·413	1·623	12·959	0·615	14·373

Protection of Food.

In Colon, during 1914, "Retail stores . . . . were required to keep bread in glass cases. The proper wrapping of bread sold was made the object of special effort. Such vendors of food products were required to use glass cases. Some 300 or more glass cases for bread and cooked food were installed in shops in Colon. Fruit stands were made to protect those fruits requiring it with glass cases."*

* Report of the Department of Health of the Panama Canal, 1914. p. 19.

SANITARY RULINGS.

Compulsory Vaccination in Siam.

Dr. Highet, Principal Medical Officer, Local Government, Siam, has written a brochure describing the progress of efforts against smallpox in Siam, culminating in the passing in 1914 of an Act by the Government of that country requiring compulsory vaccination.

He shows that smallpox, so far as Hospital returns permit of judging, is of a deadly type ; as, in a total of 379 cases observed, the death-rate was 55·9 per cent. In 1911–12 the mortality from the disease amounted to 4·3 per mille of the population.

The people have been accustomed to the use of inoculation against smallpox since 1838, when it was introduced by Dr. Bradley, an American missionary. It has been difficult to induce them to give up this method in favour of vaccination.

Efforts largely promoted by the private benevolence of H.M. the King of Siam have been made to advance vaccination and, as the campaign thus inaugurated has been received with favour by the people, it was thought that the time was now ripe to secure a diminution of the marked mortality from smallpox, by the introduction of a Compulsory Vaccination Act.

Dr. Highet says, "the basal idea is the desire to have every person now in the Kingdom, or who may enter the Kingdom, rendered immune to smallpox ; therefore, as soon as this law comes into force, every person who has not previously been successfully vaccinated must become vaccinated, unless it can be shown by a certificate from a duly qualified Public Vaccinator that he or she has previously suffered from smallpox or has been repeatedly vaccinated without a successful result." As to age for vaccination the parent is responsible that the operation be performed on a child after one month of age ; but no time limit is laid down. The people are apparently, in view of this order, expected to take advantage of the visits of the Vaccinators deputed by the Superintendent of Vaccination in any District. The object subserved is to secure that vaccination shall be chiefly conducted in the cooler months of the year ; although Dr. Highet considers this not essential as "nowadays, with railway communication, ice and thermos flasks, efficient vaccine lymph can be transported to almost every corner of the country at any time during the year."

It is required that a child which has been vaccinated be brought for inspection on the 8th day ; a certificate showing result of vaccination is then granted. In the event of an area being imminently threatened with small pox, it is provided that by notification the Minister can demand vaccination or revaccination of *all* the inhabitants of the area concerned within a specified time. Dr. Highet trusts that an addition will be made to this clause of the Act, by its being definitely laid down that revaccination during the ninth year will be compulsory. Postponement of vaccination on account of sickness of a child is arranged for.

Vaccination at appointed stations is rendered free. If the public vaccinator attends private houses, a fee, at a rate prescribed by the Minister, is laid down. Private medical practitioners may undertake vaccination ; but if they desire their certificates to be recognised for

the purpose of the Vaccination Act they are required to "take out licences as public vaccinators." No unqualified person will be recognised as a Public Vaccinator; and the lymph to be used must only be that which has been authorised by the Minister. Persons inoculating with small pox virus incur heavy penalties.

As a preliminary to the passing of the Act, a Serum and Vaccine Laboratory was opened in 1906, and by 1912 a Pasteur Institute was merged with it "under the immediate supervision of Drs. MANAUD and ROBERT—"both of whom have been trained in the Pasteur Institute at Paris."

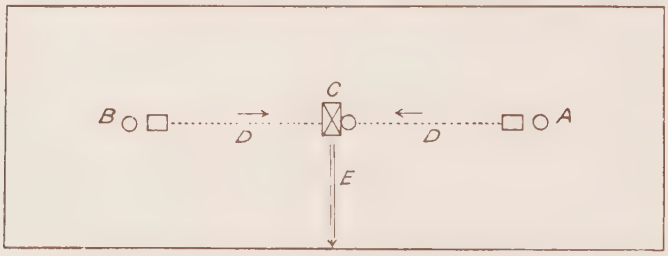
SANITARY WORKS.

The Transport of Excreta.

When pit filters attached to latrines worked on the separation system cannot be safely employed, the removal by cart of urine, washings, etc., after pumping from cesspools would bespeak heavy expenditure. Presuming however the night soil depot is distant from the town served, it would be a much less expensive matter to treat these fluids close to the town than convey them to the night soil depot—the choice of a distant site for which recognises the necessity for freedom from flies in the inhabited area, the slow conversion of night soil by the process of nitrification, or the (ordinarily) hopelessly expensive method of incineration. It should be possible to secure for certain areas of the town served sufficiently secluded spots where the fluids can be passed through rough aerobic filters* and the filtrate be applied direct to soil, or be sent by drains elsewhere after such treatment.

As an alternative to this method, it might often be convenient to arrange, in or near the town, a depot where urine could be received and, in cases where pails contents are transferred, the washings of latrine pans. From a well ventilated impervious cesspool a pump worked by animal power, or by an oil engine, according to duty expected, could lift the urine and washings and deliver them by a main of *small calibre* to any suitable distant ground or filter area for disposal.

Indeed, where the separate system is only partially adopted, there is no reason why by imitating the Berlier method (in so far as the use of small pipes is concerned) a considerable amount of faecal matter should not also be sent daily by the same delivery main, instead of by carts. The attached diagram shows arrangements on this principle



A B = Night-soil dumping depots with water supply.
C = Sump with power for lifting sewage and night-soil dumping depot combined.
D D = Sewers.
E = Main delivering sewage to farm or sewage treatment works.
The outline marks the boundary of inhabited area.

for villages (such as often found by rivers and the sea) having greater length than breadth. At A and B are night soil dumping depots. Each has a screen and dolly for comminuting hard faeces, and a well

* Plan C. this *Bulletin* (Sanitation Number) Vol. 4, No. 8.

(or other water source) from which water is lifted by pump to a cistern. From this cistern, water is supplied in measured proportion for flushing night soil, urine and pan washings through Sewers D D into a central sewage sump C, whence the total mixture is pumped to a farm or sewage works for treatment.

Transport to the distant night soil depot would demand cartage for ·234 tons of faeces per thousand of the population of vegetable eaters, against 1·35 tons of both urine and faeces transported together. As there is a daily load, there is room for economy in case of transport and staff (according as the separate system is more or less complete) by adopting, if not the methods, at least the principles suggested above. Estimates worked out in detail, under the writer's supervision, show that economy in working well warrants the initial charges of such schemes.

The Transition Stages from Night Soil Conservancy to Sewerage and Water Carriage.

The undertaking of schemes for towns piecemeal is ordinarily, from financial, sanitary and engineering aspects, erroneous. But, an exception to this rule can be found where a plant will at once relieve a town undergoing rapid expansion (such as follows increase of trade) of the night soil conservancy difficulty in respect to recurring increments of cost of transport, and, later, of the sullage trouble and, yet, ultimately may form an integral part of a complete sewerage scheme. The writer believes that in towns in the tropics not blessed with good gradients, or surplus funds, this dovetailing of the requirements of finance and sanitation *pari passu* with increase of population and its prosperity, can be well subserved by the Shone system.

Its rôle in complete sewerage schemes is of course well established. But although the capability of the Shone ejector in dealing with sludge is well recognised, it is not ordinarily known that it is perfectly capable also of lifting night soil plus urine of a population, *without any added water.*

A good example of this is to be found at Warrington, England. Here it is essential, to secure economical treatment of the night soil for the production of manure, that it shall reach the vacuum pans as free of moisture as possible. Consequently, not even the washings of night soil receptacles are allowed to be dumped into the ejector. The urine and excreta are received upon a coarse grid, and are hand-raked through it. Rarely, special extraneous matter is treated by dolly.

The population of Warrington is 72,000. Each week, 15,168 receptacles are emptied into an ejector. Under air pressure, from this the urine and faeces are forced to the depot for manufacture of manure by the fixed ammonia method. The manure sells at a remunerative price (£5–£5 10s.). All evaporation of moisture is effected by heat derived from incineration of town rubbish. The depot is 1½ miles distant from the ejector, and is 72 feet above its ground level. The material is sent forward at the rate of about 3 feet per second. The air compression station is about three quarters of a mile from the ejector. In 1901, the delivery main had been in use for nineteen years, and was then reported as "clean as polished steel," showing that no accretions

had occurred. In that year the writer, when inspecting the Warrington arrangements, was told by the late Mr. LONGDIN, the then Surveyor of the Borough, that the ejector for night soil had not cost more than £5 for repair during the whole period of use.

These works still perform duty, and fairly establish the fact that faecal matter and urine of a population can be transmitted by pipe to a distant night soil depot (if necessary considerably above the level of the dumping depot) *without added water*. The point is of importance because there are localities in the tropics where, at times of drought, water is so precious that the risk of scarcity would put any system of pipe transmission of faecal water out of the question with local authorities, unless convincing evidence were available.*

Having determined to use a Shone ejector for receipt of faeces and urine delivered at a depot within a town by the usual means of transport and thus to secure transmission to any distant point for disposal, there is no reason why, as the next step in progress, whilst a public and private latrine system is still pursued in parts of the town, sullage water of the locality in the neighbourhood of the ejector site should not also be received, by the laying down of drains from houses in the vicinity or from particular streets. In this way, by adding ejectors at intervals, according to financial possibilities, area after area of a town may be brought under successive systems of simple excreta removal, sullage removal and, ultimately, these so combined as to secure complete sewerage and its complement—water carriage of night soil.

As air pipes can be extended in any direction, there need be no increase of machinery for air compression coincident with the stages of advance indicated. Whether or not the machinery of the air compression station should, at first, be equal to the task of the present or future requirements, would depend upon the scope of ambition and funds. But it is satisfactory to know that air compression in the present day can be carried out cheaply by the use of power derived from kerosene oil engines, a matter which bespeaks economy in fuel and (when contrasted with the use of steam) in the grade of skilled staff required at the central station.

It may be stated that the system of gradual change from solely night soil conservancy in certain areas to complete sewerage by the Shone system was that followed in Rangoon.

Having become possessed of power in the form of compressed air, the tropical town in process of expansion might well find an additional rôle of usefulness for the central machinery in lifting deep well water

*Close to the spot where night soil is dumped into the ejector at Warrington is a grid through which the washings of the receptacles pass *direct* to the neighbouring sewers, and visitors to the works at times have left with the impression that this fluid is used to dilute the faecal matter. To meet such objections, the writer is able to furnish the following extract from a note kindly furnished by Mr. A. M. KER, A.M.I.C.E., the present Borough Surveyor :—"The pail contents are ejected without any added water, as there is sufficient urine in the pails to make the faeces sufficiently liquid to be dealt with by the ejector. If it were found necessary to add water, the cost of the manufacture of the manure would be greatly increased as after treatment as much water is driven off from the residue as possible so as to leave the manure as dry as possible."

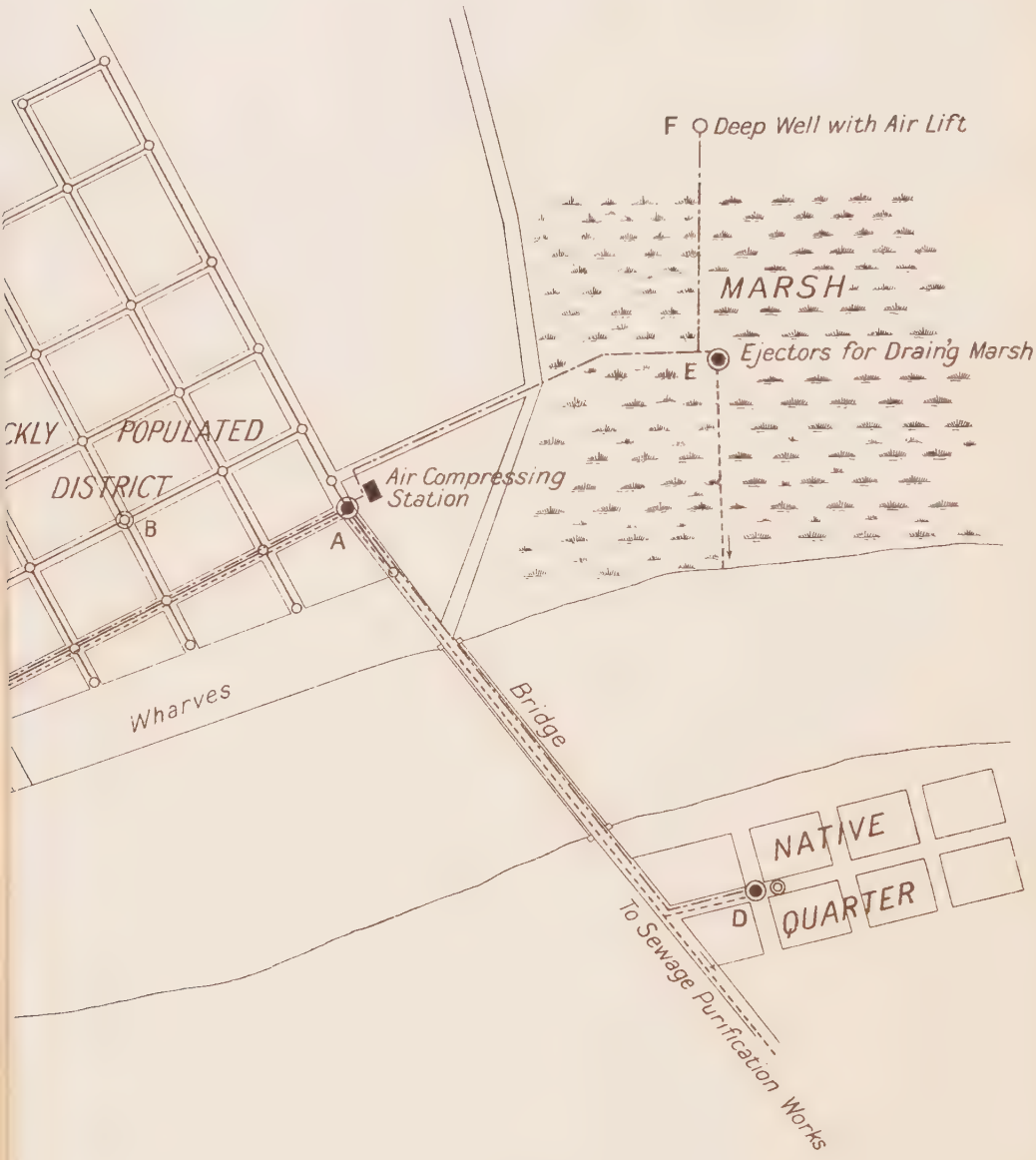
A TYPICAL TOWN

EVOLUTION OF NIGHT
AND SEWERA

4318. P1594.38. 2000. 9. 15.

IN THE TROPICS.

-SOIL CONSERVANCY
AGE SYSTEMS.



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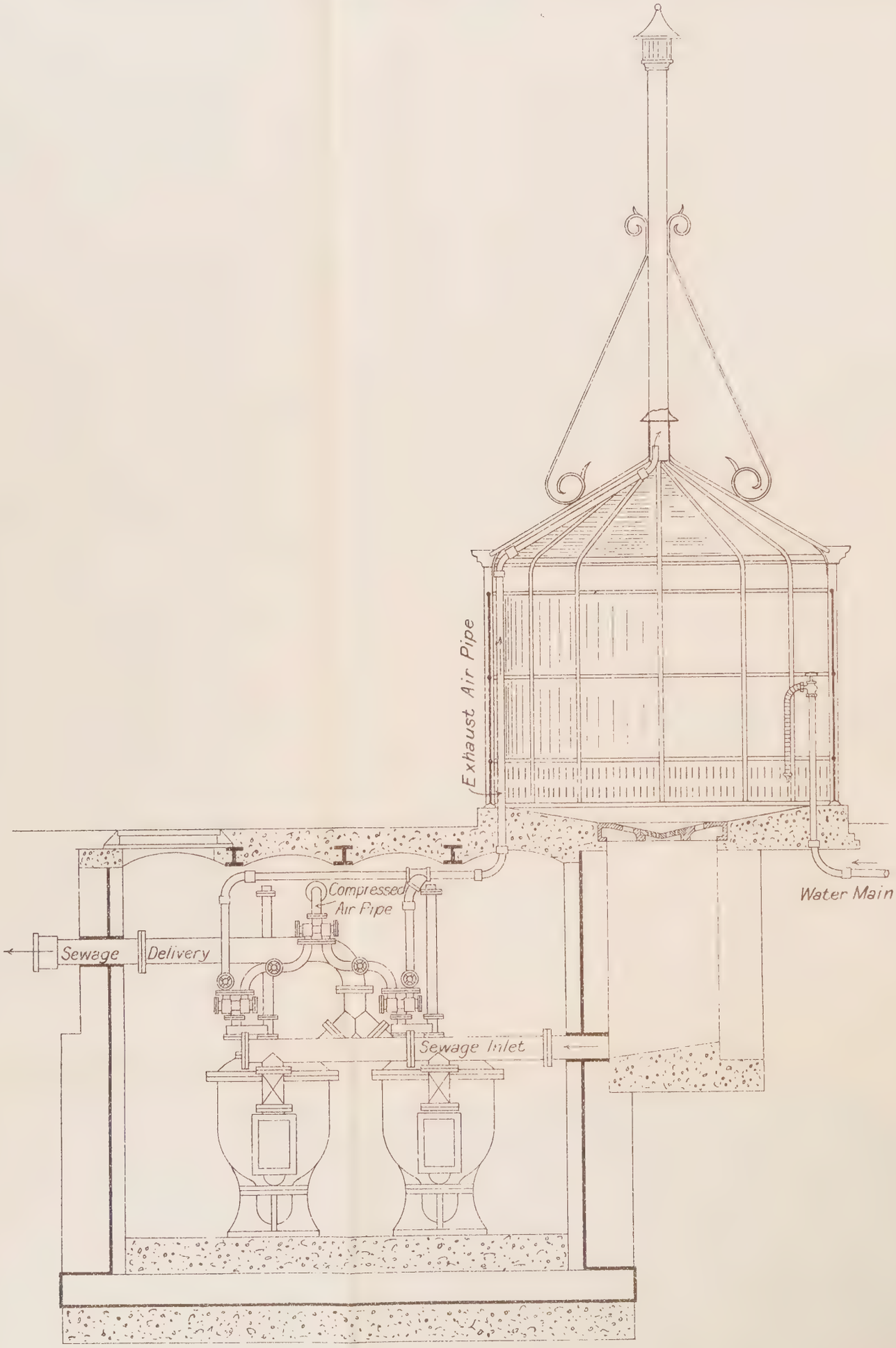
NIGHT SOIL DEPOT AND SHONE EJECTORS.



4318. P1594. 38. 2000. 9. 15.

Malby & Sons, Lith

by an air lift pump, or using ejectors in part or whole for relief of subsoil or surface water, in parts of the town subject to malaria and difficult of drainage.

The first figure exhibits a night soil depot (as per plan kindly furnished by Messrs. HUGHES and LANCASTER, Engineers, Victoria Street, London) on the Shone system, with its ejector and method of ventilating by the use of exhaust air. There is here shown a hydrant for pail washing but, as already remarked, such washings need not be effected here as an essential part of the process, nor be used for dilution of the faecal matter.

The second figure shows the adaptation of the Shone system to a typical tropical town, in accordance with its grade of expansion on the principles above indicated. The whole area is possessed of gradients that would not favour a gravitation system of sewerage, but yet, by means of short lengths of sewers serving ejectors, there can be secured the full benefit of self-cleansing velocity, without the objection of these being laid at undesirable depths. In the thickly inhabited area, sewers have been duly laid to an ejector (A) and the richer inhabitants have not only had their houses connected so as to remove their sullage water, but have adopted the water-carriage adjuncts for excreta. Mingled with these houses. however, are a few of a poorer class, where latrines are still adhered to. The night soil from these is therefore delivered by ordinary transport at the ejector station. In a certain portion of this area, however, the people are of a poor class and still adhere solely to latrine methods—public and private. This necessitates separate removal. In this case, instead of its being necessary to transport the excreta to the distant ejector station (A), it suffices to have a site over a sewer (B) arranged for dumping pail contents. The resulting economy may mean the difference between the cost of upkeep of animals and carts and hand carts drawn by the same men who collect pails.

In the sparsely inhabited area and in the native quarters for labourers, public and private latrines only are employed, whilst no sullage water removal is yet attempted. In both cost of transport of excreta is economized by direct dumping at ejector stations (C and D).

It is of course to be understood that the position of depots and ejectors is merely diagramatic and that in practice these are placed in secluded spots.

A small, yet as to malaria spread, dangerous swamp is in proximity to the thickly inhabited area. It is within a depression expensive to fill, and cannot be drained by gravitation to the river without a discharge main long (and also expensive) owing to small fall available. Here an extension of the air pipe to an ejector station (E) receiving subsoil drains would meet the difficulty, by direct transmission of the subsoil water to the river.

But the swamp is but an indication of subsoil water obstructed in its outflow to the river. At greater depths in this slope towards the river may be water of a purity that may warrant the sinking of a deep well (F) for the supply of a part of the population. Here then the pipe conveying compressed air may be delivered for the actuating of an air lift, by adaptation of the usual methods of regulating the pressure at this point, and thus save special pumping machinery. It might so happen that the subsoil water before reaching the marshy

area is potable at the site shown on the plan; in which case removal of water by the air lift for public supply would also aid the drying of the swamp.

Economy and Policy of Combined Conservancy Systems.

As regards the various combinations* described in the preceding Notes, an objection that might be urged is that it is not proved that any material saving, when contrasted with ordinary methods of transport by animal power of faecal matter, is effected; as under certain of them transport by hand carts drawn by men, or by bullock or pony carts is contemplated to a limited extent.† Nevertheless, if the annual expenditure saved (with its increments due to increasing population) in the differences between cost of transport of combined urine and excreta, or these separately, for short and long distances respectively, be regarded as interest and sinking fund on a loan for the carrying out of the systems indicated, it will be found that the more cleanly and expeditious methods suggested are ordinarily the cheapest.‡

Again, it may be objected that if a part of a town is so advanced as to demand sewerage, instead of temporizing by night soil dumping in ejector stations and in sewers till the poorer inhabitants avail themselves of water carriage, this could at once be enforced by legislation. In European towns, a class of house and a class of people within defined areas render such legislation feasible; but in tropical towns (without discussing the various reasons) as a fact, it is not so. The Sanitarian has ordinarily therefore either to let matters await the millenium, or act with discretion, in the interest of the majority, by adapting his methods to the needs of mixed classes.

The Lifting of Petty Water Supplies.

One of the difficulties attending methods of lifting water from wells by manual labour is discussed in para. xxiv of the Annual Report of the Medical Department, Sierra Leone, for 1914. This is common to the tropics, where the desire is to secure a machine of simple mechanism, sanitarily sound as to prevention of water contamination, conjoined with the ambition that it should be practically unbreakable.

In Sierra Leone "water elevators" used are liable to breakage. Hence, before expansion of their use, the necessity for employing mechanics is discussed. The Madras Government, as stated in a previous Sanitation number of this *Bulletin*, has placed its faith in "semi-rotary pumps." These are of very simple mechanism and are reasonably durable for village use: but, in recognition of inevitable mishaps with any form of mechanism, as a part of their scheme travelling mechanics have been placed in charge.

As to water-elevators, it is worth remembering that they vary in nature of material. There are some cheap varieties, possibly of foreign make, on the market, the working parts of which are of cast-iron.

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* See also Note "The filter and night soil conservancy," this *Bulletin*, Vol. 4. p. 461.

† By using Shone ejectors, the Warrington Borough Council saves on animal transport £2,000 per annum.

‡ It is of course admitted that unusual conditions of distance and cost of labour in certain localities may prove the exception to the rule.

The shock which such material gets in the hands of a villager to secure the movement of discharging the water, soon results in fracture of some material part. The moral is that *none* should be accepted the working parts of which are not of wrought iron, or better, if funds "will run to it," of phosphor-bronze. But, as the valuable function they fulfil is really the complete covering of the well mouth, instead of the use of a winch inside the dome, it should be possible to excogitate a form in which the bulk of the motive apparatus is placed outside—but covered and easy of inspection.

In obtaining pumps for Asiatics (Indians) possessed of caste sentiments, another difficulty is that no part should be fitted with leather.

Even however with the pump and the travelling mechanic provided, it does not follow, on intimation being given that a completed well is at disposal, that certain castes of Indians will use it. In parts of India, it is considered requisite that certain ceremonies be performed before a new well can be safely employed without pollution being entailed; and the not too sanguine sanitarian should arrange that a portion of the "contingencies" of an estimate be placed at the disposal of a leading man in the village concerned to see these are correctly carried out.

Pumps actuated by Kerosine Oil Engines.

By the time a village of reasonable prosperity reaches the dignity of about 5,000 inhabitants a public water supply from wells, owing to present-day cheapness of plant and the use of kerosine as fuel for engine driving, should be a possibility, if the more satisfactory method of supply of water by a gravitation system be out of the question. Although most desirable this by no means need imply "in the absence of funds" complete distribution throughout a village.

A kerosine oil engine requires little skill, provided the attendant appreciates the virtue of cleanliness. An intelligent Asiatic of the labouring class is quite capable of acquiring all the knowledge requisite. The pay for both driver and fuel therefore are ordinarily not insurmountable difficulties.

For many years, manufacturers ignored requirements when small quantities of water were to be lifted, but now cheap oil engines are to be obtained. For example, an engine and pump which will deliver 1,000 gallons per hour against a total head of 80 feet and consume only 1¼ pints of refined petroleum per hour is in the English market, at a cost of £64. Another at a cost of £68 will deliver 2,000 gallons per hour against 100 feet total head, with a consumption of 2 pints of refined petroleum. With cheap engines of this character at disposal, many difficulties as to the water supply of public institutions and villages should be solved.

By choice, a small centrifugal pump discharging into an elevated cistern with pipes and numerous taps delivering on the spot, for carriage to houses by the people concerned, meets most but not all sanitary difficulties, e.g., that of house storage. The method is however at least capable of converting a tank or well hitherto defiled by the dipping of contaminated domestic vessels, ropes, etc., into a protected *source* of water supply.

Kerosine oil engines are now being largely used in India for irrigation purposes, and facts useful to the sanitarian may be derived therefrom. Mr. CHATTERTON, the officer in charge of the Department of Industries, Madras, advises where kerosine oil is not obtainable, the use of suction gas producers employing charcoal or even wood. In the United Provinces, according to Dr. A. E. PARR, Deputy Director of Agriculture, when the lift is 20 feet and the discharge 8,000 to 10,000 gallons per hour, the oil engine affords cheaper power than bullocks. He states that the favourite installation with the landowners and cultivators for irrigation consists of a 7 or 4½ horse-power oil engine, and a 3 inch or 4 inch centrifugal pump.* Mr. Chatterton† gives a useful hint when a long delivery main is requisite :—"To avoid loss of head in the delivery main, the diameter should be nearly twice that of the pump. Recently, I have installed a 5 inch main 450 feet long to a 3 inch centrifugal pump with satisfactory results."

The mere mention of using engine power to lift village water supplies is liable to cause local authorities to have visions of exhausted funds; consequently, the following data published by a landowner, Mr. S. PANDURUNGAM, of Cuddalore, Madras Presidency, although secured in using a probably older type of oil engine than those referred to above, should sufficiently prove the writer's suggestion as to cheapness of method of lifting and, especially, the small grade of skill required in the driver :—

"I am now working with a 9½ B.H.P. engine and a 4-inch pump and the cost is :—

	Rs.	*As.*	*P.*
Liquid fuel for 10 hours at 1 gal. per hour	1	14	0
Lubricating oil, waste, etc.	0	0	6
Pay of driver at Rs.15 per mensem ..	0	8	0
12½ per cent. on the outlay of Rs.2,500 ..	0	14	0
Maintenance, renewal of belting vaporiser, etc., at Rs.200 per annum	0	10	0
The total cost for 10 hours is	Rs.4	4	0

A 4-inch pump will pump out 325 gallons per minute, and will irrigate 8½ acres in 10 hours, with one inch of water. Thus the cost of irrigating 8½ acres is Rs.4.4, or 8 annas per acre. The cost of watering 1 acre by piccotah will be at least Rs.1.8. . . . . An expert is not wanted at all to manage the engine. A farm servant, if trained, will do. I have trained a pariah farm servant on Rs.3.8.0 and a Sudra boy on Rs.7. I am going to send back the driver and put the engine in charge of one or other of the said two servants."

OPEN SURFACE OR UNDERGROUND SEWERAGE ?

In Vol. 4 of this *Bulletin* (No. 8 (Sanitation Number), November, 1914, p. 459) the writer briefly referred to the laying down of "make-shift drains," as affording at least little excuse for leaving thickly inhabited parts of tropical towns devoid of some approach to reasonable methods of sewage disposal. As a town advances in importance the necessity for radical methods must, however, force itself upon attention, and the sanitarian dealing with the subject will find himself "up

*Indian Engineering. 1915. March 27.
†Eastern Engineer, 1915. June, p. 223.

against " various, and very opposite, opinions. They are the product of two schools—those who believe it absolutely out of the question to use surface drains, and those who believe it is impossible to use underground drains in the tropics with, perhaps, a saving clause as to large cities. These opinions are complicated by the fact that, notwithstanding the proposal to use underground drains, it may not be intended to abandon any existing method of night soil collection and removal.

In endeavouring to weigh the pros and cons of the matter, it is well in the first place to get rid of the use of the term " sullage " as applied to drain contents of tropical towns. Disregarding the use of refuse water flow for the water carriage system (for which of course the open drain is not suited), the sullage from average houses is as dangerous bacterially as if it fulfilled the function of night soil carriage; as, irrespective of the occasional receipt of such fluid excreta as cholera affords, the washings of private latrines must be frequently present. Hence, the term sewage sufficiently covers requirements.

The " all open drain " school argue that, in the presence of primitive conditions of the people and an imperfect type of local administration, underground sewers imply continual risk of chokage, and that even if it is unsightly to see masses of sewage (usually accompanied by vile odours) on both sides of a street, the gas escapes into the open air and the all-beneficent sun will see to it that no harmful germ shall survive etc.

But against this it may be said that, if underground sewers are laid at proper self-cleansing gradients, are correctly controlled and provided with ordinary methods of flushing and prevention of the entrance of gross matter, choking need not occur. Further, it may be contended that the daily cleansing of open drains involves the collection and transport of sewage saturated matters and silt by special staffs and plant, especially in those of poor gradients or when velocity is retarded by road debris. Indeed in such instances if an open drain is long, the sewage may arrive at the outlet without appreciable sludge so that expensive cartage and staff are required for work that would be fulfilled by underground sewerage; and with the diurnal fluctuations of daily contents, the invert of the drains exposes material conveyable by flies in spite of the sun. Intramural open drains are not, and should not be made of a size to convey all rainfall; consequently, at some points overflow occurs at certain seasons over streets walked on by persons with bare feet, and this illustrates a mode of conveyance of sewage borne organisms which may well rival the action by flies as carriers, having regard to the habits of the races ordinarily concerned. When managed by badly supervised cleansing staffs, heaps of unremoved rubbish and silt* are found at the side of drains pending removal and, in course of time, the ground close to the drain becomes marked by accretions of dry sludge.

But the great standpoint of the all open drain party is that it is cheaper to lay such drains than underground drains. This however is far from necessarily correct. Indeed, it is rarely correct if the

* Some advantage is gained by collecting it in on a concave surface of iron mesh (after the style of a peaguard) placed over the drains, resting on the curbs during cleansing. Matter thus collected is well drained before putting into a cart for transport.

treatment of equal areas be compared, except in regard to charges for skilled supervision, when it is self-evident a better class of skill is requisite both in designing and in execution of an underground system. Those who contend for cheapness of open drains are apt to forget that, to adopt the system effectively, it is not wise to have in the course of a drain frequent curves checking velocity; consequently, to secure the reasonably straight lines of a street, buildings facing a roadway may have to be razed in part or whole, culverts and house approaches across drains have to be made, and, if the system is to be of the slightest use to the inhabitants, each house must have such grading of its premises as will permit of junction. Not only so but, unless the open drains are at times to be at undesirable depths below the roadway, either the gradient and size of the drains must be undesirably modified, or the expensive expedient of regrading the road must be made. As open drains must be on both sides of the road, the traffic space is proportionately diminished.

It is of course easy to impress a local authority with the cheapness of the open system by quoting average cost of drains per running foot; but if this average were to include the various items above suggested, and the recurring cost of staff for collecting silt and rubbish from open drains were weighed against the original cost of underground drains and their maintenance, the balance would often be in favour of an underground system; more especially if it be remembered that by the latter method water carriage of night soil can replace, in part or whole, the outlay upon night soil removal under the latrine system.

If however lack of suitable material overshadows other considerations, the writer believes a combination of the two systems, at times, may offer economy and an approach to efficiency. An open drain receiving proportionate increments of sewage, according to increasing length as area after area is served, must reach either an undesirable size or a gradient that may not be obtainable. On the other hand, if it so happens that the sewage must reach the outlet for treatment on filters or land at a level that will not demand the cost of pumping, exactly the same may be said of an underground sewer. Under such circumstances, it may be possible to devise a combined open and underground scheme that may have overflows for storm water in safe directions, and moreover in which the underground sewers may at points relieve open drains of surplus flow and thus prevent their approaching an undesirable size. This can be effected by arranging that sewers designed to divert sewage from open drains should take a new direction, so as to serve areas worked entirely by the underground system.* *The method economises available gradient to the utmost.*

However, there will always be room in argument for the supporters of both the open and underground systems and, where small villages are concerned, the latter may well yield to the former. It is in such situations that the advantage of less skill being required both in design

*The writer has seen a system laid down by a devotee to "open drains" in which whilst on two sides of a long and important thoroughfare these were manifest to the public eye and nose, in the centre of the thoroughfare there was an expensive underground sewer. To have joined on the houses to the sewer would have been an unpardonable sin against the open drain system!

and execution may turn the balance. But even this less skill may not prove economical, unless knowledge of essential points be at disposal. Hence to get information as to the designing of open drain sullage systems in tabloid form, must prove of great advantage to sanitary officers who suggest, engineers who prepare and execute schemes, and local authorities who finance them. This object has been met in a concise and most useful manner by Mr. A. G. MONTGOMERY, Sanitary Engineer to the Government of the Punjab, in a brochure which though of official origin is doubtless obtainable by purchase from the Superintendent Government Printing, Lahore, Punjab.*

* "Notes and instructions for those engaged in the preparation of schemes for the surface drainage of Punjab towns," by A. G. MONTGOMERY, Sanitary Engineer to Government, Punjab. Revised Edition. Lahore: Printed by the Superintendent Government Printing, Punjab, 1914. It is fully illustrated with plans and tables for calculations.

LANDS AND BUILDINGS.

Town Planning.

The Government of Madras has taken up the cult of town planning *con amore*. They recently engaged Professor Geddes to deliver lectures on the subject. Following this a scholarship has been founded, enabling the holder to study the subject in other countries. Further, a Special Town-Planning Officer has been appointed, who "will make himself familiar with schemes already proposed" but is not bound by them. He will arrange his tours in consultation with the Sanitary Commissioner whom he will meet at all, or most of the towns to be visited. He may consult the Sanitary Engineer whenever he finds this course necessary.

"The Special Officer will be requested to prepare his reports in triplicate, one copy being submitted direct to Government. The duplicate should be forwarded simultaneously to the Sanitary Commissioner who will be requested to submit to Government, within one month of the receipt of the report, any remarks which he may have to offer on the sanitary aspect of the Special Officer's scheme. The triplicate copy should be sent simultaneously to the Chairman of the Municipal Council who will please submit it within the same period to the Government, through the Collector of the district, with remarks."

The Town-planning Officer under the Madras Government will have a most interesting task before him, but will have more necessity for tact and patience than money in fulfilling his task. The average inhabitant of Southern India may not object to receive the very just and ample compensation which accompanies the cutting down or improvement of a dwelling, but to ask him to leave his old house for a new site is quite another matter—may he not leave all the luck behind? Under the influence of such sentiments (akin to allegiance to "mascots" in Europe and which education fails to remove), the man who has become rich will cling to the mean house where luck first came to him. Even if he buys new houses and new sites, and apparently has changed his residence, the old house will be still largely his home.

Town Planning Preliminaries.

A too frequently forgotten preliminary to the taking of any town improvements in the tropics has been kept well in mind by the Madras Government for many years, namely, the complete survey of towns. This is of course a long and laborious task in large towns, but in 28 municipal towns the work has been fulfilled up to date. In the absence of a complete survey, any effort towards settlement as to who are the owners of properties and what their boundaries is liable to become a task of Sisyphus, and a Town-planning Officer or his representatives would spend more time in law courts than in attending to legitimate expert work.

Primitive Town Planning.

Zones. According to the Annual Report for Papua, 1913–14, a village usually contains only one house, but it measures "anything from 60 feet to 130 feet in length." These houses are built on piles

and are well constructed. "A clear space of usually 60 feet is left all round the *genema* for dancing." Outside the boundaries of the dancing ground, the gardens are made.

According to the laws of Manu, Hindus are also required to leave a zone round their villages :—"On all sides of a village a space, one hundred dhanas or three samya throws* (in breadth) shall be reserved (for pasture)"—a matter of no small import as to anti-malarial measures.

Convenience of approaches. This is provided for by Manu thus :—"Tanks, wells, cisterns and fountains should be built where boundaries are met, as well as temples."

Boundaries. "And as he will see that through men's ignorance [sarcasm ?] of the boundaries trespasses constantly occur in the world, let him cause to be made *other hidden marks* for boundaries. . . . . Should the neighbours give false evidence, when men dispute about a boundary mark, the King shall make each of them pay the middlemost amercement as a fine."

Wood Pavements.

Some years back there was a crusade against wood pavements in London. Fibre particles detached by traffic and conveying microbes of sorts were blamed for creating evil conditions of the nose and throats of passengers. In the tropics how far these possible conditions are mitigated under sun action during the dry season and free washing during "the rains," has not apparently been the subject of experiment. The matter is, however, of practical importance, as there are at times great areas of alluvial deposits innocent of stones, where the expense of importation of "road metal" is greater than would be implied by the use of wood.

The Chief Engineer, Calcutta Municipality, is frankly opposed to the use of wood pavements. In a Report on the subject, he states :—

"It is going to be a failure, possibly this and certainly next rains as the expansion joint at the sides is already used up for all practical purposes and in less than two months. The executive cannot be blamed for this, as I pointed out what would happen to wood pavement in Calcutta to the committee which sat some years ago to consider the question of the best road surface. The piece of wood pavement in Clive Ghat Street which has done so well is teak wood, which is out of the question now on account of the very high cost. Teak is an oily non-absorbent timber and this and the small area of the pavement in Clive Ghat Street is the cause of its success, apart from the very good wearing qualities of teak. I am personally convinced that wood pavement cannot be a success in any climate which has long alternating periods of very dry and very wet weather."

On the other hand, neither great heat nor preference for a soft wood ("babul" *Acacia arabica*) was found to be inimical to successful wood pavement in Kurachee, as shown by the following Report of the Municipal Engineer writing in February 1894 to the Sanitary Commissioner for Madras concerning wooden pavement laid down in 1886 :—

"4. Since 1886 from 10,000 to 15,000 square feet of roadway have been paved every year, and this rate will be continued till the whole of the McLeod Road, over which the heavy traffic passes, has been paved with wood.

*200 yards for a village and 600 yards for a town.

"The work in my opinion has been a most satisfactory investment on the part of the Municipality. Where macadam was used continual repairs had to be effected, and every two years new metal had to be laid over the whole of the road; but since the wood blocks were laid, no expense for repairs has been incurred.

"There is no appearance of organic matters having lodged in the wood during the time it has been laid down, and as far as I can see, it may be regarded as sanitarily perfect in its present position, i.e. in a wide thoroughfare. I would not recommend it for small narrow streets in an Indian town where all sorts of filth and rubbish would be cast upon it.

"The cost of the paving laid complete with concrete underneath is 12 annas per square foot."

Indian Engineering discussing the Calcutta experiment (Ap. 24 1915) says, "From all accounts that we have received Merchant Street in Rangoon, which is wood paved throughout its entire length, has stood the test of time well and no complaints have ever been made regarding it."

Land Reclamation.

To drain extensive areas of land so as to render it at once fit for agriculture and no longer suitable for mosquito breeding is an ambition ordinarily checked in the bud, on the ground of lack of funds. This may be a sufficient reply; but when there is reasonable hope of simultaneously effecting economic and sanitary results, the ambition should not be abandoned without subjecting such a scheme to full estimates. The *Engineering Record* of February 6th, 1915, gives an excellent instance how, by coordination of methods in work, the problems arising from floods and the drainage of an extensive area of swampy alluvial soil, in parts heavily timbered, were solved cheaply. Notwithstanding cost of labour being greatly above that likely to be necessary in tropical countries, excavation was carried out by contract *at less than six cents per yard.*

The scheme required the construction of 300 miles of ditches and 35 miles of banks for the improvement of 300 square miles of country. Dredgers were employed for excavation. One of these, when in working order, is capable of excavating 120,000 cubic yards per month.

The minimum channel excavation was 14 ft. wide at the bottom with 8 ft. depth and ½ to 1 slopes. The maximum section is 51 ft. bottom width, and has a cross section of 800 square feet.

Jungle Clearing.

The carrying out of the anti-malarial measures of draining and clearing jungle, and subsequently converting it into useful agricultural ground, must occasionally be on so large a scale as to result in a project either being abandoned or, if carried on, being worked at intervals as funds become available. The latter method has neither financial nor sanitary merit. Any arrangement that will secure quick and economical work is therefore worthy of consideration.

An article by Le Roy W. Allison in the *Engineering Record* (New York) of July 25th, 1914 describes a "plant based upon the unit principle, and known as the Black's land clearing machine. . . . It combines the different generally used systems into one plant and affords twelve particular combinations, thus meeting almost any condition of

land and expenditure . . . operated by a gasoline engine, it consists of a five-fire Pluto stump burner, or cordwood saw, a general horse stump puller and a power stump puller."

The burner of this machine can deal with stumps up to 6 feet in diameter in 2 to 4 hours. From figures supplied, the machine is economical in working.

The following is the method of clearing practised in Papua, as reported by the Government Agricultural Department* :—

"There are on the plantation two patent stump pulling winches, which are very powerful and can be carried about very easily by two boys on account of the weight of the machine being very light. I had a severe test and there were no stumps (except large flangy ones over 8 feet in diameter) which the small machine could not operate on successfully. Now, with regard to large stumps, there is not the slightest doubt that the electric machine we have working is absolutely the best method for extracting, as every particle of the root is either blown out or the soil so loosened that there is no difficulty for the boys in picking up or digging out the small pieces left in the ground. The combination of using the stump extracting machine and blasting, if a proper method is adopted, makes a most thorough job. The following tests were made on one acre of ground which had to be perfectly cleared so that not a particle of timber would be left lying about, as it was to be used for a nursery for planting rubber seeds, and it required to be prepared in a perfect manner to prevent any fungus diseases attacking the stumps. The experiment appears to be fairly expensive, but when you consider that the ground after bush felling is not cleared in the same manner, you can calculate that the cost for blasting the stumps would be very little and nothing approaching the cost of our nursery test.

"The following was what was used and the labour employed :—

First Test, ½ acre—
Used 9¾ lbs. gelignite—2 shillings per lb., 16 sticks to lb.
,, 59 detonators—27 shillings per 100.
,, 43 labour units.

Second Test, ½ acre—
Used 21 lbs. gelignite—2 shillings per lb., 16 sticks to lb.
,, 112 detonators—27 shillings per 100.
,, 75 labour units.

"On the first test the winch grubber was used on all stumps with the exception of the very largest, and then gelignite was used. On the second test all the roots and stumps were blasted out, and the winch grubber only used for dragging out the remains of the larger trees."

*Papua Annual Report for 1913–14, p. 148.

VITAL STATISTICS.

West Indies.

In 1914, the estimated population of Grenada was 71,082. The birth-rate was 39·20 and the death-rate 21·29 per mille against 19·27 in the previous year. Of the total deaths (1,514) 31·3 per cent. were due to dysentery, diarrhoea and enteritis. Dysentery (297 deaths) was said to be epidemic.

Syphilis. In St. Vincent Dr. Hughes, Medical Officer, No. 2 District (population 9,516) states as to syphilis :—" This disease is quite as frequently seen as diarrhoea diseases of children and enjoys a greater mortality, 203 cases with 28 deaths ; and last year there were about 1,000 cases registered in the Colony. Possibly these may convey a slight conception of its prevalence and the harm it does and will continue to do."

In No. 3 District (population 10,402), Dr. Arthur states that during the last half year there were 39 deaths, of which " ten were due to diarrhoea and twelve to syphilis, more than half the number accounted for by this disease only. Eight of the twelve cases of syphilis were in infants, who inherited the disease from one or both parents."

In No. 4 District (population 6,000) Dr. Georges states :—" The chief diseases that stand out apart from the others are syphilis and infantile diarrhoea ; the former existing in both the acquired and congenital forms. . . . In contrasting the deaths out of a total of 83 syphilis claimed 19 and infantile diarrhoea 13, making a total of 32 between them or very nearly 40 per cent. Now that we have a specific for syphilis in salvarsan and its duration, there is no reason why this scourge should not be practically eliminated for the Colony. The disastrous effects of this baneful malady are too well known to require repetition."

Dr. Cremona, No. 5 District (population 4,200), states :—" Syphilis enters largely among the cases seen throughout the year and the number of cases attended to swell considerably the monthly returns."

In Grenada and St. Vincent, the above evidence shows that in respect to diarrhoea and dysentery there exists much room for Applied Hygiene, and that in the physician armed with tact and salvarsan the sanitarian would find a useful ally.

Cause and effect.

Ordinarily vital statistics speak for themselves ; so many deaths amongst infants from diarrhoea and so many from tuberculosis call aloud for Baby-saving or Anti-tuberculosis leagues and Municipalities and Councils. But the Cayman Islands statistics show that to be free of Public Bodies is to have a high birth-rate and a low death-rate. The area concerned is not measured in square miles but in acres—61,000 ; the population is 5,564, the birth-rate 36 and the death-rate 7 per mille ! The people suffered neither from malaria nor blackwater nor yellow fevers. Their total sanitary expenditure was nil. There were no Government hospitals or dispensaries, no special Health Officers or other registered practitioners, no Municipalities or Town Councils. But there were four Government schools

in which 505 scholars were registered, who showed their appreciation of benefit offered by an average daily attendance of 88. Clearly, here is an exemplification of the supremacy of education over Applied Hygiene; *or*, are the Cayman Islands waiting till imported pathogenic germs show that a "nil" expenditure under sanitation is not sound economy? Possibly also registration requires an improved subordinate agency.

Trinidad.

The infantile death-rate per 1,000 births, in 1913–14, amounted to 207 in Mayaro and 204 in St. Anns, but the "lowest rates are recorded in respect of Toco and Blanchisseuse, which have had reputations as malarial districts; and in which it appears that the rates of deaths of infants under one year of age to 1,000 births are comparatively very low, being 117 and 50 per 1,000 births respectively." This statement is interesting but unfortunately lacks statistical proof, in so far as the respective populations dealt with are not available in the Report. But so far as gross figures are concerned, Blanchisseuse shows the smallest number of deaths from malaria in the towns and wards of the Colony.

Of every 1,000 deaths, 160 were classed under diseases of the digestive system and of these 80 per cent. were due to diarrhoea, enteritis and ankylostomiasis.

Panama Canal.

On the Panama Canal, during 1914, the death-rate per mille for the white race was 6·6 and for the coloured 7·10. The constantly sick rate per mille was for the white race 23·20 and for the coloured 10·16.

Panama City* has a population of 53,948. The death-rate during 1914 was 32·85 per 1,000; the birth rate 54·52. The infant mortality for the same period was 272. Much overcrowding exists. Tuberculosis gives a death-rate of 4·26 and 12 per cent. of total deaths.

Zanzibar.

The following are the diseases which, according to the Annual Report of the Medical Department, Zanzibar, for 1912, by the Principal Medical Officer, Dr. G. A. McDonald, are those which "claim the greatest number of victims":—

1. Tuberculosis	15·9	per cent. of the total deaths.
2. Debility	14·0	,, ,, ,, ,, ,,
3. Malaria	13·3	,, ,, ,, ,, ,,
4. Diarrhoea and Dysentery	10·2	,, ,, ,, ,, ,,
5. Bronchitis..	7·0	,, ,, ,, ,, ,,
6. Dementia	5·4	,, ,, ,, ,, ,,
7. Anaemia	5·2	,, ,, ,, ,, ,,

Elephantiasis is reported to be "lamentably common." In reference to anaemia ankylostomiasis is frequent.

The crude death-rate for the whole island is 26·7 and the birth-rate is 13·7.

* Report of the Department of Health of the Panama Canal Zone. 1914. p. 8.

Captain SKELTON, R.A.M.C., writes a paper in this Report discussing the causes of the small birth-rate amongst the Swahilis. In this several possible causes are passed in review, but he does not profess to have solved the problem. He points to the first essential of means being taken to secure, either by rewards or legislation, more complete registration statistics. As the question of continuance of this race is of economic interest in Zanzibar, this step would seem to be of urgent importance.

Dr. MacDONALD concludes his remarks on vital statistics of Zanzibar with the following statement :—

"Taken as a whole Zanzibar can no longer be regarded as Burton looked upon it, that is to say, as almost a death trap for Europeans. Malaria, dysentery, debility and anaemia are all preventable and can be diminished still further."

THE CONDITIONS FAVOURING THE BIRTH RATE.

Dr. R. L. BELLAMY in the Annual Report for Papua (1913–14) makes the following remarks :—

"Conclusions drawn from only fifteen months statistics are liable to much error, but it is interesting to note that, so far as these figures go, the month of May in both 1913 and 1914 gives, in each case, the greatest number of births, viz., 33 and 42 respectively. Dating back nine months, we get September, which is the middle or height of the Trobriand village dancing. The native food crops have then been safely garnered, there is abundance of food of all kinds, there is a slaughtering of pigs, and a time of general rejoicing. Is September or its neighbourhood the breeding season for the Trobriand Islander ?"

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